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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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For related information see also *34 Fluid Mechanics and Heat Transfer*.

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Includes cost effectiveness studies.

84 LAW AND POLITICAL SCIENCE 2473
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 2473
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences*.

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 2475
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS N.A.
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 2476
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

92 SOLAR PHYSICS 2476
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 2476
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

GENERAL

99 GENERAL N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

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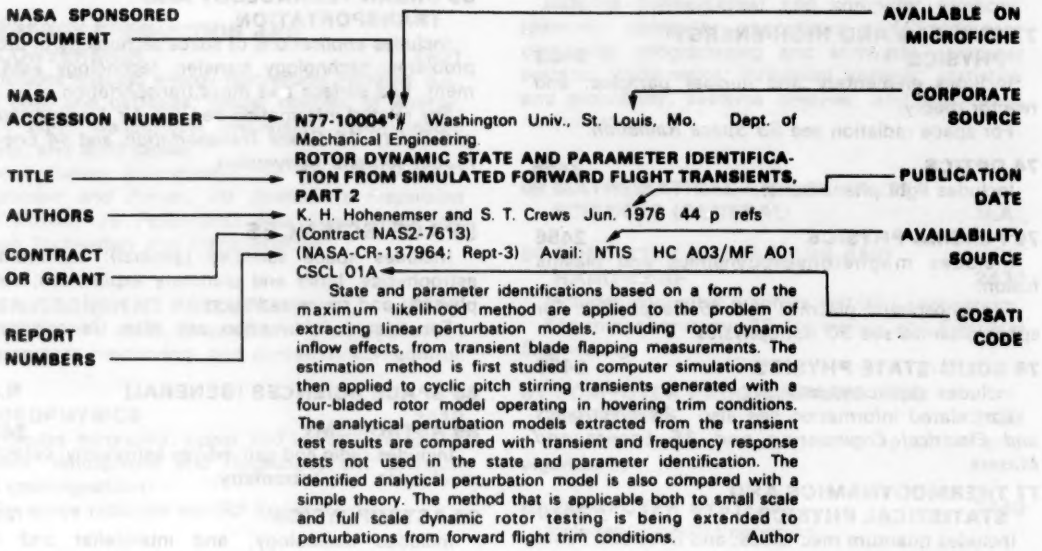
TYPICAL CITATION AND ABSTRACT



N77-10004*# Washington Univ., St. Louis, Mo. Dept. of Mechanical Engineering.

ROTOR DYNAMIC STATE AND PARAMETER IDENTIFICATION FROM SIMULATED FORWARD FLIGHT TRANSIENTS. PART 2

K. H. Hohenemser and S. T. Crews Jun. 1976 44 p refs

(Contract NAS2-7613)

(NASA-CR-137964; Rept-3) Avail: NTIS HC A03/MF A01

CSCL 01A

State and parameter identifications based on a form of the maximum likelihood method are applied to the problem of extracting linear perturbation models, including rotor dynamic inflow effects, from transient blade flapping measurements. The estimation method is first studied in computer simulations and then applied to cyclic pitch stirring transients generated with a four-bladed rotor model operating in hovering trim conditions. The analytical perturbation models extracted from the transient test results are compared with transient and frequency response tests not used in the state and parameter identification. The identified analytical perturbation model is also compared with a simple theory. The method that is applicable both to small scale and full scale dynamic rotor testing is being extended to perturbations from forward flight trim conditions. Author

ON-GOING RESEARCH PROJECTS

This is a listing of research projects – not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, EVALUATION OF MINI-HUDS
K.A. KIMBALL, U.S. Army, Aviation Psychology Division, *Ozark, Alabama* 36360 (DA0B6900)

To provide information as to whether or not numeric and/or analog LED displays focused at infinity can be effectively utilized as displays during flight with night vision goggles.

The approach will be to fabricate working prototypes of displays which can be evaluated during helicopter flight.

ADDENDA: Supporting agency address is: MDRDC Aeromedical Research Lab., Ft. Rucker, AL 36362

SUPPORTED BY U.S. Dept. of Defense - Army

1.0002, PILOT S VERTICAL FLIGHT DIRECTOR DISPLAY DEVELOPMENT
G. WOLFSON, Hughes Aircraft Company, *Culver City, California* 90230 (DN681111; N62269-75-C-0274)

To develop a pilot S highly reliable advanced television type vertical display for naval aircraft of the 1975-1980 era. The goal is to develop a display system that will provide a 1000 hour mtbf. This contract supports work unit ZA101, Agency Accession No. DN681080.

The contractor is developing a laboratory model programmable symbol generator.

ADDENDA: Supporting agency address is: Naval Air Development Center, Air Vehicle Technology Dept., Warminster, PA

SUPPORTED BY U.S. Dept. of Defense - Navy

1.0003, CONTROL THEORY FOR FLEXIBLE FLIGHT VEHICLES
A.V. BALAKRISHNAN, Optimization Software Inc., *Los Angeles, California* 90024 (DN775232; N00014-77-C-0195)

Vibrations of flight vehicles and vehicle parts (such as wings, fins, etc.) interfere with performance. The objective of this task is to see if recent developments in the area of control of distributed parameter systems can contribute to the problem of vibration reduction.

A meeting will be organized and conducted to bring together control researchers and engineers concerned with flight vehicle vibration problems. There will be great emphasis on discussion, with very few formal talks so that an understanding of what the problems are and whether or not they are amenable to recent research results can be developed.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

1.0004, SENSITIVITY OF OPTIMIZED STRUCTURES
B.O. ALMROTH, Lockheed Aircraft Corporation, *Palo Alto, California* 94304 (DF136890; F33615-76-C-3105)

Stability of structural components is one of the most important considerations in airframe design. It is known that the structural components which are critical in buckling are sensitive to initial geometric deviations. The presence of initial deviations reduces the buckling load of the structures. In the case of optimized structures the effect of the initial imperfection is seriously enhanced. The purpose of this effort is to develop a method to study this effect.

A finite element or other numerical method will be used to study the response of optimized structures with initial geometric deviations. Different structural configurations will be investigated to determine the sensitivity of each configuration.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBR, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0005, ADVANCED MINI-RPV (REMOTELY PILOTED VEHICLE) RECOVERY SYSTEM
B. KURZ, Teledyne Industries Inc., *San Diego, California* 92112 (DA0D4065; DAAJ02-76-C-0048)

To provide timely solutions for acceptable Army methods for the field recovery of small (under 200 pounds) RPVs. Major emphasis to be placed on: deployability, air vehicle damage prevention, ground crew safety, minimum set-up/teardown, mobility, and minimum acquisition/lifetime cost.

In coordination with the RPV WSM, this effort will be directed at defining an advanced recovery system for the Army's mini-RPV which corrects identified deficiencies in current state-of-the-art hardware. This will include a survey of applicable technologies, the formulation of concept designs, and trade-off studies to identify and define 'most promising' recovery concepts. Subsequent year follow-on efforts will include separate contracts for the design, fabrication, and full-scale evaluation of recovery systems defined through these efforts.

ADDENDA: Supporting agency address is: AVSCOM Air Mobility R D Lab, Eustis Dir., Ft. Eustis, VA 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0006, ADVANCED DRIVE SHAFT ALIGNMENT INDICATOR PROGRAM - ARMY HELICOPTER
R.B. BOSSLER, Kaman Aerospace Corporation, *Bloomfield, Connecticut* 06002 (DA0D4090; DAAJ02-77-C-0006)

To design, fabricate, field test and evaluate an advanced Drive Shaft Alignment Indicator (DSAI), for both static and dynamic modes as a candidate replacement for the present UH-1 and AH-1 drive shaft alignment indicator.

An advanced DSAI, based on a prototype indicator designed under a previous contract, will be fabricated. An optimum procedure using the current UH-1 alignment tools will be developed. The new DSAI along with this optimum procedure will be field tested and evaluated. At the conclusion of the field tests (approximately 55 helicopters), the previously developed AVUM procedures will be updated and a final cost and operational effectiveness assessment will be made.

ADDENDA: Supporting agency address is: AVSCOM Air Mobility R D Lab., Eustis Dir., Ft. Eustis, VA 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0007, STRUCTURAL CONCEPTS FOR LOW RCS FUSELAGE CONFIGURATION - ARMY HELICOPTERS
D.W. LOWRY, Sikorsky Aircraft Company, *Stratford, Connecticut* 06602 (DA0D4073; DAAJ02-76-C-0062)

Identify the effects of shaping helicopter fuselages for low RCS on the structure in terms of weight, complexity, and costs when compared to a baseline fuselage.

Identify the required data from the baseline Sikorsky UTTAS fuselage. Conduct a structural design analysis for equal baseline strength requirements for the three shaped helicopter fuselage designs supplied by the government. Finalize cost analysis and reporting.

ADDENDA: Supporting agency address is: AVSCOM Air Mobility R D Lab., Eustis Dir., Ft. Eustis, VA 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0008, COMPRESSOR RESEARCH FACILITY
J. UNTZ, Cadre Corporation, *Atlanta, Georgia* (DF455760; F33615-73-C-2030)

The objective of this program is to contribute to the advance of the state-of-the-art of turbine engine compressor technology by (1) supporting exploratory and advanced development of compressor design, (2) improve compressor component characteristics, (3) determine steady- state and dynamic air flow characteristics, and (4) determine effects of steady-state and transient air flow on compressor performance.

The approach is a three contract, turn key effort having five (5) phases. Phase I - detail design, Phase II - equipment procurement, Phase III - installation, Phase IV - inspection and maintenance of existing equipment, Phase V - test and inspection. AFAPL utilizes a 10-man team to monitor the program (see accession 455770 AFAPL in-house 30660412).

ADDENDA: Supporting agency address is: AF Aero-Propulsion Laboratory TBC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0009, ARMS MODEL INCREASED CAPABILITIES MODS
J. FLORENCE, Rail Company, *Cockeysville, Maryland* 21031 (DA0D4082; DAAJ02-76-C-0034)

The contract provides for the expansion of the Army Reliability and Maintainability Simulation (ARMS) model to provide the capability to simulate up to four types of aircraft, move aircraft to higher levels of maintenance, and include more than one combat threat. This contract has been modified to include a user's manual for the ARMS model to allow wider use of the computer model by any DOD agency.

Based on previous experience with the ARMS model, a list of enhancements was generated that would allow an analyst greater flexibility when using the computer program. The ARMS model will be reprogrammed to include these enhancements.

ADDENDA: Supporting agency address is: AVSCOM Air Mobility R D Lab., Eustis Dir., Ft. Eustis, VA 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0010, FIRE SUPPRESSION AND CONTROL FOR AIRCRAFT SURVIVABILITY
S. ATALLAH, Arthur D. Little Incorporated, *Cambridge, Massachusetts* 02142 (DF460210; F33615-76-C-2127)

To develop a capability for suppression and control of fires in areas of an aircraft where the potential for combustible fluid leakage, high airflow and high temperature or other ignition sources co-exist. Primary emphasis is on the engine/nacelle fire problem.

A contractual effort will develop and test a material or concept which will provide rapid initial extinguishment of an engine/nacelle fire and prevent its reignition in a high airflow, high temperature environment. The program will also identify concepts suitable for utilization of the developed material.

ADDENDA: Supporting agency address is: AF Aero-Propulsion Laboratory SFH, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0011, ENERGY CONVERSION - COMPRESSOR BLADE FLUTTER MEASUREMENT USING RETROREFLECTORS
J.L. KERREBROCK, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DN775111; N00014-77-C-0106)

The objective of this project is to assess the viability of compressor blade flutter measurements utilizing a retroreflector technique under development at Aerodyne Research, Inc. The effort is experimental in nature and is aimed at direct measurements of aerodynamic damping coefficients in terms of interblade phase angle, tip Mach number, and pressure ratio. This research will contribute to an increased understanding of the effects on performance of one of the limiting factors in the design of fan and compressor blades (blade flutter), and hopefully result in increased performance of gas turbine engines needed for naval aircraft propulsion, but useful as well to marine power plants and fixed installations.

An instrument designed, built, and calibrated by Aerodyne Research, Inc. will be procured by the M.I.T. Gas Turbine Laboratory. It will be utilized in an M.I.T. blowdown compressor to conduct blade flutter measurements for correlation with conventional ongoing flutter research.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

1.0012, DISPLAY DEVICE VISUAL CRITERIA
G.T. CHISUM, U.S. Navy, Crew Systems Department, *Warminster, Pennsylvania* 18974 (DN481351)

To determine the capabilities and limitations of the human visual system under airborne operational conditions requiring the use of advanced display devices, and to specify the visual criteria which the designs of advanced display devices must meet. The criteria must be enumerated in such a fashion that they can be readily used by the engineers and physical scientists who design and develop the displays. The requirement for this work unit was established by GOR 45.

Visual performance data will be collected using basic laboratory techniques. That data will be used to specify the visual design criteria and constraints for visual displays for sighting, tracking and detection devices. Experimental and theoretical evaluations of proposed and prototype devices will be performed and recommendations based on the results of the evaluations will be made.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Research Adminstrator (310C), Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

1.0013, EVALUATION OF SAFE ZONE ESCAPE INDICATOR CONCEPTS THROUGH DYNAMIC SIMULATION
E.R. ATKINS, Vought Aeronautics Company, *Dallas, Texas* 75222 (DN681279; N62269-76-C-0017)

To develop a display system which will provide the aircrew man with sufficient information to make a timely eject decision. This contract supports work unit ZA101, Agency Accession No. DN681080.

Perform flight test to evaluate display in the flight environment. Analyze results and prepare report.

ADDENDA: Supporting agency address is: Naval Air Development Center, Crew Systems Dept., Warminster, PA

SUPPORTED BY U.S. Dept. of Defense - Navy

ASTRONAUTICS

Includes Astronautics (general); Astrodynamics; Ground Support Systems and Facilities (space); Launch Vehicles and Space Vehicles; Space Transportation; Spacecraft Communications; Command and Tracking; Spacecraft Design, Testing, and Performance; Spacecraft Instrumentation; and Spacecraft Propulsion and Power. For Related Information See Also Aeronautics.

2.0001, ORBITAL PHOTOGRAMMETRIC TRIANGULATION WITH TRANSLATIONAL AND ROTATIONAL DYNAMICAL CONSTRAINTS

J.L. JUNKINS, Univ. of Virginia, School of Engin. & Appl. Sci., *Charlottesville, Virginia* 22903 (DA0E9282; DAAG29 77 G0018)

To develop improved methods for orbital photogrammetric triangulation which has a potential for resulting in improved prediction aspects of the orientation of the spacecraft. Relevance - accurate mapping and point positioning have obvious relevance to a variety of military activities. The planned work shows promise of contributing to a better capability for controlling photogrammetric procedure from spacecraft. Engineer topographic laboratories and Defense Mapping Agency scientists have attested to the relevance of the proposal.

Methods will be developed to reduce the number of unknown parameters and thus simplify the consideration of the translationally and rotationally constrained variables of a camera in space. The central new idea is that the rotational motion of the camera (spacecraft fixed) must be a rigorous solution of the spacecraft's rotational equations of motion.

ADDENDA: Supporting agency address is: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, ABSOLUTE REACTION AND QUENCHING RATES OF VIBRATIONALLY EXCITED HYDROXYL RADICALS BY INORGANIC AND ORGANIC MOLECULES

B.J. FINLAYSONPITTS, Calif. State Univ. & Colleges, School of Math. Sci. & Engin., *Fullerton, California* 92631 (CHE76-23577)

The goal of this research is to establish the effects of reactant vibrational energy on the rates of reacton in a series of exothermic bimolecular exchange reactions in which the vibrational energy is greatly in excess of the activation energy. The investigation involves studying the physical quenching and chemical reactivity of vibrationally excited hydroxyl radicals particularly in the ninth vibrational level (v' equals 9). Reactions of OH(v' equals 9) with the following molecules are to be studied; CO, H2, HCl, HBr, HI, H2O, H2S, NH3, CH4, C2H6, and C3H8. In addition, preliminary studies of the reactions of OH(v' equals 9) with C2-C4 olefins, benzene and toluene, which at pressures of a few torr undergo more complex addition reactions with OH(v' equals 0), will be carried out. Total rates of removal of OH(v' equals 9) will be determined in a low pressure (1 torr) fast flow discharge system; the predominant removal path - reaction and/or quenching - will be established by analysis of the yields of the major products using gas chromatography and by examination of the relative intensities of the vibration-rotation bands from 500 to 1100 nm. For those molecules whose rates of chemical reaction differ significantly from the corresponding rates for OH(v' equals 0), temperature studies (240-440 degrees K) will be performed to determine whether the excess vibrational energy changes the effective activation energy or the preexponential factor. These rate constant data will aid in developing computer models of chemical processes in the upper atmosphere, in auroras, and in comets where hydroxyl radicals have been observed. In addition, this research will clarify the reactions of vibrationally excited OH in several combustion systems where it is known to be present.

SUPPORTED BY U.S. Natl. Science Foundation

3.0002, SURFACE STATES ASSOCIATED WITH CHEMISORBED SPECIES 12925-C

S.R. MORRISON, Stanford Research Institute, *Menlo Park, California* 94025 (DA0G5576; DAAG29 75 C 0017)

To follow the adsorption and interaction of various gases with active centers at a solid surface. It is also planned to initiate investigations on the interactions of various species from the liquid phase with active centers at a solid surface. Results from this research have potential value for the control or enhancement of surface reactions such as corrosion, photolysis, and catalysis. Specific applications include the development of sensing for gases, selection of materials, and the enhancement of integrated circuit technology.

Interactions will be monitored by observing the resulting changes in the electrical properties of semiconducting supports. Theoretical techniques will be used to describe the system and analyze the interactions.

ADDENDA: Supporting agency address is: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

3.0003, INVESTIGATION OF ORGANIC MATRIX MATERIALS FOR HIGH TEMPERATURE COMPOSITES

W.G. SCHECK, General Dynamics Corporation, *San Diego, California* 92112 (DN490046; N00019-75-C-0252)

To select an organic matrix for use in aircraft composite structure operating at 450 degrees F or higher.

Screen prospective resins for thermal, oxidative, and hydrolytic stability, mechanical and physical properties, processibility and cost. Determine methods of prepregging and processing these resins with selected graphite fibers reinforcement.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0004, MECHANICS OF COMPOSITE MATERIALS

G.A. HEGEMIER, Univ. of California, School of Engineering, *San Diego, California* 92038 (DF044960; F49620-76-C-0024)

AF function - advanced aerospace vehicles require improved thermal and erosion resistance materials and structures to meet mission objectives. Opportunity - three-dimensional carbon-carbon materials for rocket nozzles and hypersonic vehicles now being considered by the Air Force require material and structural characterization in order to reduce development uncertainties. Objective - the objective of this research is to develop a basic mechanics model of composite materials based on constituent properties in order to predict failure and damage under dynamic loadings. How work contributes - this research is part of the joint AFOSR/ONR program to develop a basic understanding of carbon- carbon and graphite structural behavior.

Emphasis will be placed upon the following research tasks: (1) extension of the thermodynamic theory of elastic-plastic wave propagation at finite deformation to predict global and local stress and deformation fields in composite-material geometries, (2) extension of the present continuum theory, which includes debonding for certain geometries, to include the prediction of disturbed microcracks and/or voids throughout the microcomponents (i.e., to predict failure modes and provide a measure of damage accumulation), (3) extension of the present continuum theory to include the influence on material properties of initial microcracking, and to include the prediction of residual material properties following passage of a stress wave through the composite, (4) extension of the present models to include certain types of erosion resulting from high-speed particle impact and (5) extension of present geometries to include random, as well as periodic, microstructure.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0005, ELECTRODE POLARIZATION STUDIES IN HOT CORROSION SYSTEMS

O.F. DEVEREUX, Univ. of Connecticut, Inst. of Materials Science, *Storrs, Connecticut* 06268 (EY-76-S-02-2960)

Hot corrosion of structural metals, iron, chromium, nickel, steel, and stainless steel, will be studied via electrode polarization in electrolytes which may arise in coal gasification reactors, specifically, molten sodium carbonate equilibrated with various sulfur- bearing reducing gas mixtures. Gas chemistry will be controlled by control of PH2, PCO, and PH2S, with a total pressure of one atmosphere and a temperature of 1000 degrees C. The nature and activity of other gas and liquid-phase species will be

determined by thermodynamic modelling. Parallel manometric studies will be conducted on the nature of the gas/metal reaction in the absence of an electrolyte. These studies are intended to yield both empirical design data and detailed information concerning the nature of the hot corrosion reactions in these systems, and thermodynamic and kinetic parameters pertaining thereto.

RESULTS: 1) Thermodynamic analysis of a thirteen component gas/molten salt system containing H2, CO, H2S, Na2CO3 and derived species giving phase compositions versus independent compositional parameters at 1000 degrees C. 2) Design, construction, and operation of an electrode polarization cell for operation in molten Na2CO3 under controlled atmosphere.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

3.0006, ELECTRON-DISLOCATION INTERACTIONS AT LOW TEMPERATURES

J.M. GALLIGAN, Univ. of Connecticut, School of Engineering, *Storrs, Connecticut* 06268 (EY-76-S-02-2305)

This work is concerned with the interaction of mobile dislocations with electrons at low temperatures, especially in lead and lead alloys, and in copper. In addition we are working on partition of silver atoms, in lead alloys, between interstitial and substitutional sites, which is ascertained by yield stress measurements on quenched samples.

RESULTS: The present results have shown that dislocations move as underdamper oscillators at low temperature, in lead and lead alloys; similar results have been obtained in copper. We have also measured the partition of silver solutes in lead between substitutional and interstitial sites.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

3.0007, THEORY FOR STRUCTURES OF MOLECULAR LIQUIDS AND SOLUTIONS

D. CHANDLER, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (CHE76-04771 A01)

Several investigations are planned which are based on theories which have been recently developed to describe the equilibrium structures of relatively complex molecular liquids. For nonaqueous fluids it is planned to use the interaction site cluster series to develop a perturbation theory which describes the effects on the intermolecular correlations of slowly varying forces in molecular fluids. This work will supplement the RISM theory which provides a method for understanding the effects of short ranged harshly repulsive forces. Another project based on the interaction site cluster series is the development of a theory for the pair correlation functions for mixtures of molecular liquids. The derivation of a theory for molecules with internal degrees of freedom is also planned. In particular, work is planned to determine how the intramolecular structures of non-rigid molecules depend on liquid environments. Projects for aqueous systems are also planned. Here, the work will be based on a recently developed theory for liquid water. Finally, investigations concerning non-uniform systems are planned that may lead to more fundamental understanding of the mechanism for freezing in simple systems and the mechanism for isotropic-anisotropic fluid phase transitions in liquid crystal systems. This work is a continuation of that currently supported by Foundation grant MPS-7308591.

SUPPORTED BY U.S. Natl. Science Foundation

3.0008, HIGH-DENSITY FUEL COMBUSTION

M.T. MCCALL, Martin Marietta Corporation, *Baltimore, Maryland* 21227 (DN590099; N00019-76-C-0200)

Information is needed on the combustion properties of high-energy- density candidate fuels for air-launched missile systems. Some ignition delay data are available to date.

Combustion duration of the fuel in air will be determined under varying conditions of pressure and equivalence ratios. Studies will be carried out in both initial and reflected shock waves.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0009, HIGH-DURABILITY MISSILE DOMES - CHEMICALLY VAPOR-DEPOSITED SPINEL AND MAGNESIUM OXIDE

J. PAPPIS, Raytheon Company, *Waltham, Massachusetts* 02154 (DN675315; N00014-76-C-0635)

Future tactical missiles of the Navy will need IR domes, radomes and dual mode capabilities. Materials now used are not suited for such applications because the operating environment will impose severe conditions such as mechanical and thermal loading, impact-caused erosion, and effects such as optical and electrical property changes. The possibility of dual mode operation emphasizes the need for greatly improved or novel materials. In addition to possessing useful mechanical, thermal, optical, electrical and chemical properties, such materials must have the potential for being economically fabricable. Chemically vapor-deposited (CVD) spinel, and coated CVD magnesium oxide (MgO) appear to satisfy these requirements. This research task will investigate areas of processing research materials characterization and property determinations which will (1) minimize or eliminate surface deterioration of MgO, (2) establish the suitability of CVD spinel as a potential dome material and (3) develop CVD processes suitable for use in dome fabrication.

The surface protection of MgO and the CVD process for spinel will be investigated in parallel efforts. The best approach will be continued in depth. Spinel will be deposited on MgO by CVD and reactive methods. The purposes are to eliminate or minimize effects of hydrate and carbonate formation and erosion damage. Exploratory CVD spinel runs will be made to obtain small rectangular pieces. Optical, mechanical, and thermal properties of materials produced will be determined (transmittance, image spoiling, strength, elastic modulus, hardness, thermal conductivity, thermal expansion, specific heat, microstructure, environmental stability).

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0010, GREASE ANALYSIS

P. SENHOLZI, U.S. Navy, Air Engineering Center, *Lakehurst, New Jersey* 08733 (DN696007)

To determine the feasibility and effectiveness of 'grease analysis' as a diagnostic technique.

Develop a grease analysis technique and determine its diagnostic effectiveness through laboratory and field application.

ADDENDA: Supporting agency address is: Naval Air Systems Command (AIR-340E), Washington, D.C.

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0011, DESIGN OF LIGHTWEIGHT ARMOR SYSTEMS

C.D. DONALDSON, Aeronautical Res. Associates, *Princeton, New Jersey* 08540 (DF138820; F33615-76-C-3156)

This work unit supports the area of armor material development of aircraft application. Aircraft survivability can be greatly enhanced if critical subsystems on board the aircraft can be protected from impacting projectiles or fragments. Lightweight and low-cost armor design concepts, such as those to be investigated in this effort, could have a significant payoff for Air Force applications. It is the objective of this program to study the projectile penetration process and to identify, based on this, the most suitable armor material properties and to identify materials that exhibit such properties. The payoffff can be greatly enhanced weapon system effectiveness in the hostile threat environment as well as reduced system acquisition cost.

Continue development of the integral theory of impact with emphasis on the application to the design of lightweight armor. The contractor will determine, based on experimental impact data, whether the heat of fusion of materials may be used to effectively design lightweight armor systems.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FES, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0012, REDUCTION OF MIXED SPINEL OXIDES
L.C. DEJONGHE, Cornell University, School of Engineering, *Ithaca, New York* 14850 (EY-76-S-02-2584)

The objective of this program is to investigate the response of mixed spinel oxides to a reducing environment at high temperatures. Specifically we investigate the changes in microstructures and reduction kinetics as affected by solid solution additions of alumina and magnesia to spinels such as cobalt ferrite, nickel ferrite and magnetite. The kinetics will be determined by thermogravimetrical analysis and measurement of rates of layer growth. To allow for quantitative interpretation of these rate measurements, the reduction layers forming on partially reduced oxides are fully characterized by electron microscopy and optical techniques with respect to micromorphology and to composition.

RESULTS: Rate measurements have been performed on pure and Al3 ions containing nickel ferrites. The presence of Al3 ions drastically changes the scale morphology, in that it confines reduction more to grain boundaries, and inhibits the sintering of surface metal layer through formation of nonreducible aluminate particles. The reduction kinetics reflect these micromorphological developments.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

3.0013, INTERNAL STRUCTURE AND PHYSICAL PROPERTIES OF CERAMICS, METALS, AND ALLOYS AT HIGH TEMPERATURES
W. TRIPP, Systems Research Labs. Inc., *Dayton, Ohio* 45432 (DF680990; F33615-75-C-1005)

AF function - high-temperature propulsion materials. Thermal protective materials and power generator materials. Deficiency - failure of materials to perform at high temperatures due to oxidation, loss of strength or lack of requisite physical, chemical or mechanical properties. Research - studies of the kinetics of the degradation of metals and ceramics exposed to reactive environments will be combined with microstructural and compositional studies of the matrix and reaction products to determine the degradation mechanism and to suggest potential material improvements. The relationship of composition, defect structure, and microstructure of selected new ceramic materials to their mechanical and physical properties over a wide range of temperatures will be determined to improve their potential for structural, propulsion, and energy conversion applications. How research contributes - an understanding of the fundamental mechanisms responsible for the mechanical, physical, and chemical properties of materials under extreme conditions of applied stress and temperature is essential if significant long-range improvements in these materials are to be made. Once the mechanisms are known, modifications in material composition, microstructure, and surface condition can be undertaken in a more scientific manner to improve material behavior, and new development efforts.

The structure/property studies will require detailed investigation of the raw material and processing factors that influence microstructural development of metals and ceramics, the role of thermodynamic variables in fixing the defect structure and transport properties of these materials, and the role these factors play in determining the mechanisms underlying physical and mechanical properties of technological importance, such as electrical conductivity, high- temperature corrosion, diffusion, sintering creep, strength, deformation and fracture.

ADDENDA: Supporting agency address is: AF Materials Laboratory LLM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0014, COMPOSITE SPECIMEN FABRICATION AND TEST
R.T. ACHARD, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF139700)

This work unit is supportive to preliminary design and evaluation of advanced structural composite materials and basic material processing techniques, and is to include activities related to construction and testing of standard specimens and representative structural geometries using advanced composite materials. The capability to explore technology under parallel investigation by civilian industry, on a much reduced scale, leads to a more thorough understanding and to some degree allows anticipation of problems related to technology development for Air Force aircraft structures application. The objectives of this effort are to perform in-house fabrication and assessment of payoff potential, through inspection and test, of composite structural concepts, arrangements, and geometries including bonded assemblies and hybrid assemblies where applicable. The in-house approach allows for direct dollar savings as well as indirect savings associated with more timely responses to current problems. Timely responses based on thorough understanding permits a more time- and cost-effective approach to the solution of problems inherent in advanced structural design and development.

Efforts within this work unit will include, but not be limited to, the following: fabrication of unique test specimens, analysis and test of composites in various simulated environments, fabrication of fracture mechanics coupons, development, fabrication and test of elastomeric tooling concepts, support of composite investigations by other laboratory agencies as requested, investigation of an automatic scanning dielectric spectrometer, for monitoring and improving composite cure cycle efficiency, creation and maintenance of displays illustrative of composite applications in airframes, and conducting of tours and presentations explanatory thereof as required.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBSC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0015, TURBINE ENGINE LUBRICANT RESEARCH
H.A. SMITH, U.S. Air Force, Aero Propulsion Lab., *Dayton, Ohio* 45433 (DF451270)

Establish basic parameters of turbine engine lubricant degradation from which new and improved methods and guidelines for assessing and defining the performance capability of current and advanced high- temperature lubricant can be made. Correlate the physical and chemical characteristics of wear particles with the mechanisms of wear occurring in turbine engine lubrication systems.

Lubricant capabilities determined by bench/rig techniques and by full-scale engine testing will be studied using advanced and analytical methods of analyses. Changes in the rates and modes of lubricant degradation will be identified for each test technique. Establish changes required in the test parameters which will provide correlation between laboratory test results and turbine engine performance. Study wear mechanisms and wear particles using the ferrograph coupled with microscopy and correlate wear particle data with performance of operational lubrication systems.

ADDENDA: Supporting agency address is: AF Aero-Propulsion Laboratory SFL, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0016, THE ROLE OF HYDROGEN IN THE STRESS CORROSION CRACKING OF HIGH-STRENGTH ALUMINUM ALLOYS
I.M. BERNSTEIN, Carnegie Mellon University, Inst. of Technology, *Pittsburgh, Pennsylvania* 15213 (DF046820; F49620-77-C-0003)

AF function - hydrogen embrittlement is a serious problem that causes mechanical property degradation in our most significant aircraft materials including steels, titanium, aluminum and nickel-base alloys. Opportunity - hydrogen-related phenomena are suspect of playing key roles in the mechanisms of stress corrosion cracking, subcritical crack growth, hot salt corrosion, weld cracking, temper embrittlement, fatigue crack growth, and brittle fracture in general. Objective - this investigation will identify the role played by hydrogen in stress corrosion cracking of high-strength aluminum alloys through determination of microstructural and fractographic correlations with cracking, direct observations of cracking, permeation studies, and mechanical tests under cathodic charging conditions. How work contributes - the various forms of hydrogen-related mechanical property degradation severely restrict the serviceability of our important aircraft materials. Basic understanding of the manner by which hydrogen acts to reduce mechanical strength and cause failures is important if we are to minimize and control these forms of attack.

Specific emphasis will be placed on the role of metallurgical variables such as precipitate type, size and distribution, to develop these as control variables for the production of high-strength aluminum alloys (7000-series) more resistant to hydrogen embrittlement and/or stress corrosion cracking.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NE, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0017, AN INVESTIGATION OF THE MECHANISMS OF ORDERING IN SOME NICKEL-BASED BINARY ALLOYS

D.E. LAUGHLIN, Carnegie Mellon University, Inst. of Technology, *Pittsburgh, Pennsylvania* 15213 (DMR76-22353)

This is a basic investigation to determine the various ways by which a super-saturated solid solution can decompose into a disordered terminal solid solution and a coherent ordered phase. The specific alloys under study include nickel-molybdenum, nickel-vanadium, nickel- manganese, and nickel-beryllium. The experimental techniques used include transmission electron microscopy (diffraction and magnification mode), x-ray diffraction, microhardness and tensile tests. The continuous ordering mode of transformation is particularly emphasized in this program, in light of its potential as a transformation mode in important superalloys. It is expected that knowledge gained on the transformation modes in the binary alloys studied will advance understanding of phase stability and transformation modes of more complicated multicomponent alloys.

This is a renewal of NSF Grant DMR75-10618.

SUPPORTED BY U.S. Natl. Science Foundation

3.0018, DIRECTIONAL SOLIDIFICATION OF NONOXIDE EUTECTICS 14069-MS

V.S. STUBICAN, Penn. State University, School of Engineering, *University Park, Pennsylvania* 16802 (DA0E9298; DAAG29 77 G0057)

Study the directional solidification of several refractory carbide and boride compositional systems which exhibit eutectics, and relate the resulting microstructures to selected mechanical properties of the materials. Relevance - the materials to be studied may find use as high- temperature unlubricated bearings for helicopters, as ceramic tool bits, as high-temperature ceramic turbines and adiabatic diesel engines for Army vehicles, and as high-temperature missile components.

Determine the crystallography of the eutectic systems and elucidation of the fundamental factors which determine the topotaxial relations, measure the three and four point bend strength of the specimens as a function of temperature up to 2000 degrees C, and evaluate the microhardness and wear resistance of the specimens.

ADDENDA: Supporting agency address is: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

3.0019, THE EFFECT OF GRAIN SIZE ON THERMAL DIFFUSION IN METALS

J.P. STARK, Univ. of Texas, School of Engineering, *Austin, Texas* 78712 (DF034770; AF-AFOSR-2343-72)

The application of materials to critical components of Air Force systems often demands that the mechanical and physical properties be stable, and that heterogeneity and segregation be minimized during processing, fabrication, and lifetime of the part. One significant problem area is related to exposure to high temperature. At high temperatures, the stability of mechanical and physical properties, as well as homogeneity of material composition, can be significantly altered. In metals, the redistribution of solutes can be a particularly acute problem when a temperature gradient is the driving force for segregation. However, very little is known about the effect of metallurgical structure on the amount of segregation in a temperature gradient. This research is concerned with an experimental evaluation of the effect of one such structural variable, namely, the effect of grain size and grain boundaries upon the driving force for thermal diffusion is to be examined. Concurrent measurements with varying solute concentrations will clarify the nature of the kinetic factors responsible for this segregation. Such an understanding is relevant to the engineering evaluation of any alloy to be used in a temperature gradient. In particular, this research relates to many problems that arise during long-term service of structural and engine components at elevated temperatures.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NE, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0020, THE EFFECT OF AN IMPRESSED ELECTRIC FIELD ON THE METAL WORKING OF AIRCRAFT STRUCTURAL MATERIALS

L.R. CORNWELL, Texas A & M University System, School of Engineering, *College Station, Texas* 77843 (DF047030; AF-AFOSR-3193-77)

AF function - Russian scientists have recently reported that plastic deformation of aerospace metals is strongly influenced by impressed electric fields and currents. This research offers a fundamental study of this phenomenological event so that aerospace vehicles, propulsion systems and structural materials might thereby be improved. Opportunity - a scientific explanation of the Russian breakthroughs in this area does not now exist. The opportunity and needs for this research is critical for the national engineering community and results are urgently required. Objective - the objective of this work is to properly characterize the effect of an impressed voltage on an aeronautical aluminum alloy. The phenomenalistic events are to be interpreted for extension to real systems involving deformation mechanics. How work contributes - part of the AFOSR mission is to provide a scientific understanding for complex engineering or technological problems. This research will serve the interests of the USAF by giving solutions to foreign technology problems which are not yet understood.

As a first step to assessing the application of this so-called electroplastic effect to practical problems, the simple expedient of rolling an aluminum alloy while an electric current is being applied is suggested. The rolling load will be monitored and the per cent ductility determined and compared to the corresponding values in the absence of an electric current. The resulting mechanical properties and microstructure will also be determined to assess the effect on these parameters. Analytically, the program will interpret the data and results in terms of mechanical metallurgy so that improved metalworking methods for solid mechanics might thereby be improved.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0021, A PRECISION DILATOMETER STUDY OF QUENCHED METALS AND ALLOYS

P. WILKES, Univ. of Wisconsin, School of Engineering, *Madison, Wisconsin* 53706 (DMR76-04730)

This is a basic study of select quenched metals and alloys, using an ultrahigh-sensitivity capacitance micrometer, capable of detecting length change of less than one Angstrom. This technique will be used to determine the vacancy volumes for nickel where the enthalpy (Ef) and vibrational entropy (Sf) for vacancy formation are known. It will also be used to determine Ef and Sf for aluminum, gold, silver and copper, for which the vacancy volume is known. In the latter case, the volume change for divacancy formation will be determined. Lastly, the effect of solute atom additions on Ef and Sf will be determined for dilute alloys of atoms with different diameters and/or valencies from the matrix.

SUPPORTED BY U.S. Natl. Science Foundation

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, EFFECT OF SOLUTE-VACANCY PAIRS ON THE PHYSICAL PROPERTIES OF SI-DOPED GAAS, AND OTHER COMPOUND SEMICONDUCTOR SYSTEMS

W.G. SPITZER, Univ. of Southern California, School of Engineering, *Los Angeles, California* 90007 (DF043410; AF-AFOSR-2990-76)

AF function - microwave electronic devices are essential elements of Air Force communications, reconnaissance, surveillance and countermeasure systems. Opportunity - improved performance of these systems can be expected from use of better materials in devices that process microwave signals. Present microwave solid-state device performance is limited by the defect structure in device materials. Objective - the objective of this research program is to obtain a more complete understanding of the defect structure of Si-doped GaAs and to track the effects of simple defect species on properties of GaAs that are important for signal processing devices. How work contributes - changes in quantities such as carrier density, infrared absorption, vacancy loop size and density, yield stress and luminescence caused by changes in thermodynamic conditions will be correlated and all explained on the basis of a common defect model.

The effect of varying concentrations of Si and thermal treatments on the free carrier concentration, infrared absorption, photoluminescence, critical resolved shear stress and defect structure of Si-doped GaAs will be systematically investigated.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NE, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0002, DYNAMIC SYSTEMS

D.G. LUENBERGER, Stanford University, School of Engineering, *Palo Alto, California* 94305 (DF046370; AF-AFOSR-3141-77)

AF function - the design and integration of electronic systems and aerospace vehicles. Deficiency - the optimal design of complex systems is hampered by the problems of effectively interfacing constituent parts and subsystems. Although the state space basis of dynamic systems and their optimal configuration are now well developed, the application of these principles to even moderately complex problems is often too difficult for cost-effective implementation. Objective - to develop systematic theories of approximations, and to unify the existing useful design methods that have evolved from ad hoc ideas. How work contributes - progress achieved in this area would permit more sophisticated and powerful systems to be designed and built in a cost-effective manner.

The initial efforts will consider three interrelated projects - positive systems, aggregation, and information simplification. Positive systems arise frequently in practice, and the theory is the most advanced here. Therefore, the known results can serve as a standard for comparison in treating other systems. The theory can be used as a tool also in investigating the long-standing problem area of aggregation. The topics of information simplification can be attacked by methods of aggregation.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0003, ION DOPING OF GAAS N-TYPE STRUCTURES

J.W. MAYER, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (DF260730; F19628-73-C-0174)

AF function - invulnerability of ICBM's. Deficiency - solid-state circuits are very vulnerable to radiation damage. Research - study metal-semiconductor interfaces, alkali halide surfaces, and ion implantation doping of GaAs. How research contributes - radiation- hardened GaAs FET's are presently limited by the high resistance at the source and drain. This investigation will seek to lower this resistivity. The objective of this study is to look at metal- semiconductor interfaces with ion backscattering and to produce, in conjunction with ion doping, low resistivity contacts. Ion migration and metal-silicide formation, as is required for Schottky diodes, will also be investigated. In addition, the feasibility of using ion back- scattering techniques to study alkali halides will be investigated. Alkali halides are being developed as laser windows in high-power systems.

ADDENDA: Supporting agency address is: AF Cambridge Research Laboratories LQ, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0004, RADIATION-HARDENED QUARTZ

T.M. FLANAGAN, Intelcom Rad. Technology, *San Diego, California* 92138 (DF901440; F19628-76-C-0266)

AF function - reconnaissance, surveillance, navigation, communications, command and control. Deficiency - AF satellites require highly accurate timing mechanisms, based on precise frequency standards which employ quartz crystal oscillators and filters. Present quartz material is affected by nuclear and space radiation and shows excessive aging characteristics. Objective - to specify conditions leading to the production of quartz crystals that satisfy the system requirements of radiation hardness and minimal aging. How research contributes - it will be determined which of the currently used production processes are capable of yielding radiation-hardened quartz and how such processes can be specified.

Synthetic quartz material will be selected from several different commercial processes and characterized by impurity analyses. Pre- irradiation resonator characteristics will be established. Oscillator response to radiation environment and post-irradiation resonator characteristics will be measured. The results will be evaluated in terms of candidate process specifications.

ADDENDA: Supporting agency address is: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0005, RESEARCH STUDY ON CONFORMAL AND ADAPTIVE ANTENNA ARRAYS

R.C. HANSEN, R.C. Hansen Incorporated, *Tarzana, California* 91356 (DN590195; N00019-76-M-0690)

Research study on conformal and adaptive antenna arrays.

Information from a number of Navair conformal array antenna research contracts will be assembled in a handbook to aid future system contractors in the design of such antenna arrays. Data from previous conformal array contracts will be collected and organized. In addition computer codes prepared under these contracts will be exercised to obtain the requisite curves and tables, and to fill any missing design data areas.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, D.C. 20360

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0006, MIXING AND COMBUSTION MECHANISMS IN HIGH-SPEED AIR FLOWS

R.B. EDELMAN, Science Applications Inc., *Woodland Hills, California* 91364 (DF047420; F49620-77-C-0044)

AF function - advanced air-breathing engines, airborne weapons delivery. Deficiency - insufficient understanding of basic mechanisms and processes involved in advanced high-speed combustors and lack of realistic guidelines for predicting propulsion system performance. Objective - to formulate realistic mathematical representations of mechanisms and processes associated with turbulent reacting flow fields encountered in advanced air-breathing combustors, and augmentors, e.g., dump, premixing/prevaporizing, annular burners, common and mixed-flow afterburners. How work contributes - will provide additional understanding and realistic analytical modeling of reactive flow fields not now available and contribute to advanced air-breathing engine technology base. Present advanced propulsion system design and development depend heavily on expensive cut-and-try methods.

Theories describing chemical kinetics and mixing phenomena in subsonic and supersonic fuel-air flows will be formulated and evaluated. Included will be investigation of transport phenomena in nonreacting and reacting flows. Mechanisms will be studied for accelerating and enhancing mixing and combustion

processes to minimize length for combustion completion, including coupled chemical and mass transport processes with pressure distribution and geometric effects. Effects of sudden expansion and effects of interphase transport including particulate phase evaporation on injection and mixing, ignition, flame stabilization and propagation, and on combustion instabilities and efficiency will be studied. Also studied will be coupling of mechanisms describing ignition, combustion and mixing processes associated with direct injection of multiphase fuels into high-speed air streams. Various fuels will be investigated including hydrogen, hydrocarbons, including those derived from non-petroleum sources, slurries and metal particles.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0007, APPLICATION OF TWO-PHASE LIQUID METAL MHD POWER SYSTEMS TO PROPULSION

J.S. LEONARD, Shearwater Incorporated, *Stonington, Connecticut* 06378 (DN675226; N00014-76-C-0467)

To study the application of LM-MHD power systems for naval propulsion purposes.

Using existing naval vessels to establish baseline values for start-up, maneuvering, ships' electrical requirements and space/weight configuration considerations, a complete conceptual description of a naval LM-MHD power and propulsion system will be established.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0008, MIXED FREE AND FORCED CONVECTION IN TURBULENT FLOW

R.J. ADRIAN, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DES 74-14962)

Current higher order closure models are being modified to incorporate buoyancy effects and applied to the problem of calculating the structure of turbulent flow when turbulence is produced by a combination of mean shear and heat flux induced buoyancy. Homogeneous flows and inhomogeneous boundary layer-type flows are considered for Richardson numbers ranging from minus infinity to critical. It is found that in some models the empirical parameter that corresponds to von Karman's constant is in fact a function of Richardson's number. The objective is to assess and refine models for predicting turbulent flows that are complicated by buoyancy effects. Experimental studies of unsteady turbulent free convection are also in progress.

SUPPORTED BY U.S. Natl. Science Foundation

4.0009, AERODYNAMIC HEATING OF CONVENTIONAL WEAPONS

D. MAPLES, Louisiana State Univ. Systems, School of Engineering, *Baton Rouge, Louisiana* 70803 (DF047840; AF-AFOSR-3250-77)

AF function - aerodynamic heating of external stores is an Air Force problem with high-performance aircraft. It has been specifically indentified as such in AFATL TPO-8. Deficiency - research is needed to better quantify the limitations of existing stores and to provide research alternatives to these stores where critical to performance. Objective - to conduct basic research in aerodynamic heating of conventional weapons with ultimate goals of quantifying the phenomena and providing research alternatives to existing limitations. A subsidiary objective is to design and help establish a suitable research laboratory at AFATL with completion in FY 79. How research contributes - the research will provide a basic understanding of aerodynamic heating effects on conventional weapons, through which the deficiency can be reduced or eliminated. The research contributes to RO 4.2.11 and RO 6.2.5.

The facility will be used to experimentally investigate the problem and research will be conducted to improve the state-of-the-art in thermal scale modeling.

ADDENDA: Supporting agency address is: AF Office of Scientific Research XO, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0010, NAVY VEHICLE DESIGN AND CONSTRUCTION - BOUNDARY VALUE AND NATURAL FREQUENCY ANALYSIS OF THIN SHELL STRUCTURES

B.K. DONALDSON, Univ. of Maryland, School of Engineering, *College Park, Maryland* 20740 (DN675635; N00014-76-C-0872)

The objective of the proposed research effort is to establish an improved approximate method of analysis for the determination of natural frequencies of naval ships, aircraft and missile systems.

The approach used will be to employ an extended field method, with continuum mechanics models, such that the boundary conditions are satisfied by the field approximations thus providing for convergence as well as more accurate and efficient solutions than are possible with the Rayliegh-Ritz or finite-element techniques currently being used for vibration analysis of thin shell structures.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0011, RADIATION EFFECTS IN SI AND GAAS FOR DEVICE DEVELOPMENT AND HARDENING

H.M. DEANGELIS, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF279700)

AF function - surveillance and reconnaissance. Deficiency - performance characteristics of electronic devices are degraded by space radiation environments and those created by nuclear weapons detonations. Objective - determine the properties of radiation-induced defects in electronic device materials including the effects of high-energy electrons and neutrons on silicon and gallium arsenide materials suitable for use in infrared detectors and microwave power devices respectively. How research contributes - radiation-induced displacement damage changes the properties of device materials. Data concerning the production and stability of the defects responsible for these changes provides a basis for predicting the effects of radiation on device performance and in evolving techniques to radiation-harden materials and devices.

Carrier removal, defect energy levels and defect concentrations are derived from hall effect and conductivity measurements on bulk samples and from capacitance measurements on p-n junction and Schottky-barrier diodes. Recovery of property changes and defect stability are determined from isochronal and isothermal anneals.

ADDENDA: Supporting agency address is: AF Cambridge Research Laboratories LQ, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0012, NONLINEAR OPTICAL PHENOMENA IN SOLIDS

P. KRUSE, Honeywell Incorporated, *Minneapolis, Minnesota* 55413 (DF046920; F49620-77-C-0028)

AF function - aerospace communications surveillance and detection systems require devices which exploit special properties and interactions of infrared radiation with solid-state materials. Opportunity - the far infrared region of the electromagnetic spectrum has been virtually unexplored for military applications. Narrow bandgap semiconductors offer technological promise for spin-flip Raman laser sources and as infrared detectors of objects against a cold space background in the spectral range 15 to 30 microns. Objective - this research investigates (Hg, Cd)Te single crystals as a useful material for generating nonlinear coherent far infrared sources and detectors. Also, it seeks an understanding of the properties of narrow bandgap semiconductors which make it resistant to laser damage. How work contributes - the interaction effects and unique properties of (Hg, Cd)Te should provide a basis for developing useful tunable, far infrared sources and detection for adverse weather communications and radars, astrono-

my, spectroscopy and plasma diagnostics needed for aerospace electrooptical and electromagnetic devices.

Crystal growth and characterization studies are being undertaken. (Hg, Cd)Te crystals are grown by the modified Bridgman (quench/anneal) technique. Spatial profiles of the single crystals are determined by measuring their composition and purity, density, Hall coefficient resistivity and optical absorption. Spin-flip Raman laser studies are conducted on a sample prepared for laser cavities. Evaluation includes spatial uniformity of the Raman signals and optimum electron concentration for aerospace applications requiring far infrared tunable lasers.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NE, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0013, SUPPORT OF LARGE-SCALE INTEGRATED CIRCUITS

J. BAUER, U.S. Navy, Air Engineering Center, *Lakehurst, New Jersey* 08733 (DN796004)

Develop testing techniques for LSI digital circuitry for operational use in the 1980-90 time frame. The prime objective is to provide for the support of these complex, densely packed circuits.

Test requirements for 1980-90 digital avionics systems have been determined by an investigation of state-of-the-art trend and industry studies in digital testing and maintenance philosophy. These studies will be closely coordinated with advanced digital technologies, built- in-test, and in-flight performance monitoring philosophies. Upon completion of the studies, a demonstration model was built to provide for the evaluation of the concepts developed. A study is presently underway addressing microprocessor applications.

ADDENDA: Supporting agency address is: Naval Air Systems Command (340E), Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0014, CALCULATION OF NUCLEAR ENVIRONMENT

J. JANNI, U.S. Air Force, Weapons Laboratory, *Albuquerque, New Mexico* 87117 (DF189550)

The primary objectives of work under this task are to maintain and improve a unique in-house capability to calculate the nuclear environment created by one or more high-altitude detonations, and to develop and improve satellite system support.

Projects in support of the above objectives are carried out by both in-house development and contract. The work is used to provide planning support to a variety of USAF and DOD organizations.

ADDENDA: Supporting agency address is: AF Weapons Laboratory DYC, Kirtland AFB, N. Mex 87117

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0015, DEVELOPMENT OF AN INTERFERENCE-FREE, SELF-ADJUSTING, TRANSONIC WIND TUNNEL

R.J. VIDAL, Calspan Corporation, *Buffalo, New York* 14221 (DN223122; N00014-77-C-0052)

The ability to predict the performance of aircraft at transonic speed depends critically upon the accuracy of experimental data obtained in wind tunnels. Such data are plagued by uncertain corrections because of the presence of the constraining walls of the tunnel. This research will explore a new concept, based on the measurement of two flow variables in the test section, for eliminating or drastically reducing the influence of the tunnel walls throughout the subsonic and transonic speed range.

At transonic speeds, the ability to establish wind tunnel wall corrections is seriously hampered by an inadequate description of the complex flow in the vicinity of, and through, the tunnel walls--walls which are either porous or slotted. To circumvent this inadequacy, the proposed investigation will rely on the measurement of two flow variables in the test section far from the model. If wind-tunnel wall corrections are present, these measurements, when continued mathematically to infinity, will not correspond to undisturbed flow. When this is the case, the porosity and/or the pressure external to the walls will be changed until the continuation to infinity results in undisturbed flow. The study will be composed of several facets: a theoretical investigation of appropriate methods for solving the transonic equations in the far field; the establishment of accuracy requirements to meet the unboundedness condition at infinity; model tests in a small tunnel with conventional walls and the new proposed wall control; and equivalent free air tests in a large wind tunnel to assess the wall control.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0016, NONLINEAR AND ACTIVE OPTICAL DEVICES

C.L. TANG, Cornell University, School of Engineering, *Ithaca, New York* 14850 (ENG76-11729 A01)

The main objective of this program is to conduct research on active nonlinear optical devices for use in optical communication systems. In particular, the effort will be directed towards the following investigations: (1) Electrically tunable semiconductor lasers, (2) High peak power, short duration semiconductor lasers, (3) Fast optical detector using a microwave field effect transistor (FET). This device utilizes a waveguide adjacent to the gate of a microwave FET.

This action continues the research supported under NSF Grant ENG76- 11729.

SUPPORTED BY U.S. Natl. Science Foundation

4.0017, EFFECT OF BODY FORCES ON MOTION AND HEAT TRANSFER OF CONFINED FLUIDS

S. OSTRACH, Case Western Reserve Univ., School of Engineering, *Cleveland, Ohio* 44106 (DF046540; AF-AFOSR-3171-77)

AF function - advanced aerospace vehicles. Opportunity - improve efficiency of electronic equipment cooling systems, waste heat disposal and fuel cooling systems. Objective - to increase the understanding of confined flows and heat transfer relevant to fuel and hydraulic systems, tankage, and aircraft equipment environmental control. How work contributes - this work is building a step by step understanding of flow features and configurations that are common, albeit poorly understood, features of vehicle equipment operation. Any increased understanding of these flows will yield hydraulic fuel and temperature control systems of better performance and decreased weight.

Experiments will be performed on heat transfer augmentation by thermal instability, on natural convection with multiple heat flow directions, on the interaction of a buoyant plume in a stratified environment, and on convection due to combined temperature and concentration gradients. Papers will be prepared describing completed work.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0018, PULSE DENSITY MODULATION

T.C. HARTRUM, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321480)

The objective of this effort is to develop the theory of operation of pulse density modulation, and to evaluate this modulation technique as a communication system. Pulse density modulation is a stochastic modulation technique based on the operation of biological neural systems. The communication system will offer advantages in security, jamming resistance, and per channel bandwidth reduction.

A feasibility model of a pulse density modulator/demodulator system has been built based on experimental measurements of physiological systems. This hardware will be used to guide theoretical development and to verify theoretical results. Based on these results, improved receiver design will be proposed, and system performance will be evaluated.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0019, ISOKINETIC SAMPLING/SONIC
J.A. MARTONE, Oregon State Higher Educ. Sys., Graduate School, *Corvallis, Oregon* 97331 (DF407650; F08635-76-M-0016)

The objective of this work is to determine the errors associated with deviations from isokinetic sampling conditions while sampling for aerosol particles in air streams flowing at near-sonic (perisonic) velocities. Disagreement exists concerning the particle size (aerodynamic) at which isokinetic sampling becomes important. By resolving the issue many air sampling operations, such as those for turbine and rocket engines and those employing high velocity aircraft, may be designed using non-isokinetic approaches, thereby greatly reducing sampler cost and operating complexity.

A high-speed air flow system will be constructed capable of speeds from 0.5 to 1.2 Mach. An aerosol generation system will be fitted to the inlet to seed the inlet air with aerosol particles of a known size. The aerosol will be sampled using a filtration technique prior to acceleration using isokinetic techniques. The aerosol will be sampled again following acceleration to perisonic speeds. The latter samples will be withdrawn under both isokinetic and non-isokinetic conditions. at least 3 particle sizes will be studied, approximately 0.1, 0.5 and 1.0 microns. Results will show the sampling errors associated with various degrees of deviations from isokinetic conditions. These results will be compared with theoretical predictions and generalized predictive equations will be developed.

ADDENDA: Supporting agency address is: AF Civil Engineering Center EVA, Tyndall AFB, Fla 32401

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0020, AUTOMATIC RECOGNITION AND TRACKING OF OBJECTS
J.K. AGGARWAL, Univ. of Texas, School of Engineering, *Austin, Texas* 78712 (DF046640; AF-AFOSR-3190-77)

AF function - the development of Air Force weapon systems is becoming increasingly dependent on the real-time automatic detection, identification, and tracking of targets. Opportunity - at present, the ability of machines to perceive their environment is very limited. Current pattern recognition systems are capable of only identifying objects with simple contours or identifying a very limited set of target signatures. How work contributes - this effort will advance the Air Force capability in detecting, identifying, and tracking targets. Objective - the overall objective of this research is to develop computational and experimental tools for the analysis of aerial color photographs of a complex scene containing objects which are small, moving, and possibly occluding one another.

The research program includes the extension of the existing scene- analysis algorithms to the recognition of curved objects in a scene, the study of the role of motion in order to enable the application of the recognition system to real situations like detecting and tracking of objects, and the use of color information for extracting meaningful objects from the background of the given scene as well as for detecting and tracking the objects from the aerial color imagery.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NE, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0021, WIDE BAND FIBER OPTIC DATA TRANSFER
J.R. BAIRD, Spectronics Incorporated, *Richardson, Texas* 75080 (DF098360; F33615-74-C-1160)

To establish the status of state-of-the-art components and techniques for point to point wide band data transmission using fiber optic technology.

The contractor will be responsible for the design, development, fabrication, demonstration, and evaluation of a point to point, wide band, (greater than 100 mhz) fiber optic data link, capable of transmitting and receiving analog and baseband digital information. Signal formats, typical of AF high-data-rate equipment, will be used in conjunction with the total evaluation of the system. The link will be deliverable and will be used in-house for further testing.

ADDENDA: Supporting agency address is: AF Avionics Laboratory AAT, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0022, MIXING-CHEMISTRY INTERACTION IN CONTINUOUS COMBUSTION
D.T. PRATT, Utah Higher Education System, School of Engineering, *Salt Lake City, Utah* 84112 (ENG76-84533)

Two distinct analytical methods of computer modeling of high- intensity, turbulent, backmixed continuous combustion will be developed further, and the resulting models will be compared with experimental flame stability limits, heat-release and pollutant formation rates in both a modified laboratory jet-stirred reactor, and developmental prototypes of low-emission automotive and aircraft gas turbine combustors. The two methods are: 1. Solution of the governing partial differential equations for conservation of mass, momentum, thermal energy and mass fractions of chemical species, utilizing conventional finite difference schemes, turbulence models and turbulent reaction models. 2. Coalescence/dispersion or 'Monte Carlo' stochastic mixing/reaction model. The two methods will also be combined; in the hybrid model, method 1 will be used to predict residence time distributions and spatial distributions of turbulence parameters, which will in turn be utilized as required input to model 2 simulation. The models will be compared with experimental data on blowout limits, stationary-state temperature and species concentrations obtained with the cooperation of investigators at the Washington State University. Similar, although less-detailed, data from low-emission gas turbine combustors will be obtained from the General Motors Research Center and the AVCO-Lycoming Corporation.

SUPPORTED BY U.S. Natl. Science Foundation

4.0023, AUTOMATED MOTOR SKILLS TRAINING OPTIMIZED FOR INDIVIDUAL DIFFERENCES
R.C. WILLIGES, Virginia Poly. Inst. & St. U., Graduate School, *Blacksburg, Virginia* 24061 (DF046460; AF-AFOSR-3161-77)

AF function - many Air Force synthetic flight trainers are computer-controlled devices which can be programmed for individual training to enhance their training effectiveness. However, it is necessary to optimize training by allowing for individual differences. Deficiency - because each student is unique in terms of experience, learning rates, approach to the training environment, and control styles, a single pre-determined training program is not always optimum for each individual. Objective - the objective of this research program is to investigate procedures for providing computer-adaptive motor skills training which is optimized for student individual differences. How research contributes - research to determine how training strategy interacts with previous experience, as well as with demographic variables, will assist in determining the proper training model to use with a particular student.

A two-pronged research program plan is proposed to investigate several of the fundamental research issues underlying the use of automated procedures in motor skills training. These issues deal with individual differences in motor skills acquisition and the investigation of parameters of adaptive training systems. Experimental investigation of these two issues is needed before direct applications and optimizations of automated motor skills training procedures can be made to Air Force operational synthetic flying training devices.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NL, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, OBSERVATION OF UPPER ATMOSPHERIC DISTURBANCES CAUSED BY TYPHOONS AND OTHER TROPICAL STORMS

R.J. HUNG, Univ. of Alabama, School of Science & Engin., *Huntsville, Alabama* 35807 (INT76-08745)

The cooperating scientists, Dr. R. J. Hung, University of Alabama, Huntsville, and Dr. J. J. Chen, National Central University, are carrying out research to investigate the dynamics of coupling between the lower and upper atmosphere during periods of typhoons and other tropical storms. Multiple Doppler remote-sensing techniques are being employed to investigate typhoons in Taiwan and the information obtained is being compared with data obtained from observations of hurricanes in Alabama.

SUPPORTED BY U.S. Natl. Science Foundation

5.0002, MIDDAY AURORAS AT THE SOUTH POLE STATION

S. AKASOFU, Univ. of Alaska, Geophysical Institute, *Fairbanks, Alaska* 99701 (DPP75-22592 A01)

The objective of this research is to achieve a better understanding of the morphology of dayside auroras and their relationship to the interplanetary magnetic field. The growth and decay of multiple area auroras are of special interest. Auroral data for this study will be taken with an all-sky camera at South Pole Station.

No logistics support is required.

SUPPORTED BY U.S. Natl. Science Foundation

5.0003, CONSTRUCTION OF AURORAL ALL-SKY CAMERAS FOR THE INTERNATIONAL MAGNETOSPHERIC STUDY (IMS)

T.N. DAVIS, Univ. of Alaska, Geophysical Institute, *Fairbanks, Alaska* 99701 (ATM74-00269 A03)

This supplement to NSF grant ATM74-00269 A02 will enable the Geophysical Institute, Fairbanks, Alaska to complete the construction of 10 all-sky cameras for the International Magnetospheric Study (IMS). Increased costs in Alaska are responsible for this request and the need for all 10 cameras requires NSF's support.

SUPPORTED BY U.S. Natl. Science Foundation

5.0004, ULF STUDIES AT THULE, GREENLAND

R.R. HEACOCK, Univ. of Alaska, Geophysical Institute, *Fairbanks, Alaska* 99701 (DPP76-22331)

A digital fluxgate magnetometer and a fast response riometer will be installed and operated at Thule, Greenland. The data obtained will be used to investigate the coupling of pulsations in the interplanetary magnetic field with the magnetosphere, and to investigate the rate of interplanetary shocks and structure in producing hydromagnetic waves in the magnetosphere.

SUPPORTED BY U.S. Natl. Science Foundation

5.0005, STUDIES OF N2 VIBRATIONAL DISTRIBUTION IN THE AURORAL F REGION

G.G. SIVJEE, Univ. of Alaska, Geophysical Institute, *Fairbanks, Alaska* 99701 (ATM75-02185 A02)

A coordinated set of measurements is being conducted in order to try to tie down the storage of energy during auroral excitation. The N2 vibrational states are presumed to be the intermediate storage medium. The results of this study should be useful in understanding these basic processes. This is the second year of a 30-month grant.

SUPPORTED BY U.S. Natl. Science Foundation

5.0006, TRACKING AND MONITORING OF HURRICANES BY HF SKYWAVE RADAR OVER THE GULF OF MEXICO

J.W. MARESCA, Stanford Research Institute, *Menlo Park, California* 94025 (DF044800; F49620-76-C-0023)

AF function - the Air Weather Service has a technical need for remote measurement of tropical cyclone parameters. Deficiency - in the early developing stages of a tropical cyclone, the center of the cyclone, as determined by satellite data can be displaced from the surface center by as much as 100 nautical miles. At nighttime, the coarser resolution of the satellite IR sensor present problems in locating the tropical cyclone. Objective - HF radar technology will be used for remote sensing of the sea surface conditions and surface winds in tropical cyclones. Contribution - the availability of a remote wind sensing capability with OTH radar will permit a significant reduction of the weather reconnaissance flights with little or no degradation of the present existing forecast capability. This will be a cost effective measure.

The SRI radar (OTH) will be used as an active radar. The tropical storm area will be illuminated by a beam of radio waves originating at this radar transmitting site, and the radio waves reflected (backscatter) from the storm area are detected by a highly directional antenna located at the radar receiving site. The recorded backscatter data will be analyzed to track and monitor hurricanes to determine the sea state and surface winds.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NP, Bldg. 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0007, PHYSICS OF GEOTHERMAL SYSTEMS

W.H. DIMENT, U.S. Dept. of the Interior, Geological Survey, *Menlo Park, California* 94025 (9940-01178)

STATES TO WHICH PROJECT PERTAINS: Western states, mainly California, Idaho and Nevada.

OBJECTIVES: To examine the temperature distribution in, and thermal properties of, geothermal systems that have been drilled. To make measurements of temperature, thermal conductivity, porosity and permeability in these systems as opportunities arise. To integrate such measurements or observations with any other sources of information so as to obtain a better understanding of geothermal systems with a view toward discovery and exploitation of other systems. Specific target areas include The Geysers/Clear Lake region, CA; Raft River Valley, ID; Mesa Area, CA; and other opportunities as they arise.

To examine the nature, configuration, and properties of the continental lithosphere with a view to better defining areas favorable for geothermal development. To integrate available geologic, gravity, magnetic, seismic, electrical, heat production, heat flow, satellite imagery, and chronologic data with this view in mind.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

5.0008, ARCTIC ENGINEERING GEOLOGY (TAPS)

A.T. OVENSHINE, U.S. Dept. of the Interior, Geological Survey, *Menlo Park, California* 94025 (9310-00002)

STATES TO WHICH PROJECT PERTAINS: Alaska.

For the Technical Advisory Board to the Department of Interior Task Force on Oil Development and for the Federal Task Force on Alaskan Oil Development, review reports and proposals concerning the Trans-Alaska Pipeline System (TAPS) in terms of their accuracy and merit, prepare (in collaboration with other government agencies) environmental and technical stipulations controlling the planning, construction, and operation of the proposed pipeline, and made recommendations in regard to possible alignment changes and special engineering-geologic problems, all of which are intended to help in minimizing any adverse effects the pipeline might have on the environment.

Collect, synthesize, and prepare for publication, engineering-geologic data that will aid in determining the proper route, design, construction, and maintenance of TAPS, and that will provide similar aid to other engineering activities generated by the petroleum-related development of northern Alaska.

Collect and synthesize basic geologic data concerning the character and distribution of permafrost and engineering soils along the pipeline route.

Evaluate new techniques, such as remote sensing, that will aid in the rapid determination of the distribution and character of permafrost and other geologic-environmental features and consequently will facilitate solving engineering-geologic problems.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

5.0009, PENINSULAR RANGES TECTONICS
V.R. TODD, U.S. Dept. of the Interior, Geological Survey, *San Diego, California* 92037 (9540-01625)

STATES TO WHICH PROJECT PERTAINS: California.

Review and synthesis of existing historic, seismic, geologic, and geodetic records of all faults with known or suspected Late Quaternary activity. 2) Study of satellite and high-altitude (1:90,000 to 1:230,000 scale) photography and other imagery for linear and other structural features that appear to reflect Late Quaternary tectonic activity. 3) Study of known or suspected young faults by intermediate- scale air photos (including low-sun-angle photos) and by detailed geologic mapping. Determination for each active fault of length, width of hazardous zone, distribution and nature of adjacent landslides, character, rate and chronology of past displacements from historic slip events, and Late Quaternary stratigraphic and geomorphic record. 4) Compilation of bedrock geologic maps at scales of 1:24,000 and 1:62,500. Landslides will be mapped by photointerpretation, and consolidated deposits will be classified and mapped.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

5.0010, BLUE-GREEN PROPAGATION THROUGH CLOUDS
H.G. HUGHES, U.S. Navy, Propagation Technology Div., *San Diego, California* 92152 (DN687625)

Evaluate the effects of multiple scattering on the propagation of optical frequencies in the blue-green band through aerosols. Particular emphasis will be given to the effects of aerosol distributions in clouds.

Conduct measurements of the transmission losses through aerosols for an optical wavelength of 0.53 micron utilizing a pulsed, frequency- doubled neodymium-YAG laser. The effects of multiple scattering and resulting pulse stretching will be determined as a function of receiver field-of-view at a fixed distance from the laser source. Simultaneous measurements of aerosol drop-size distributions and atmospheric parameters affecting EO propagation will also be made to allow comparison of the measured results with propagation prediction computer codes.

ADDENDA: Supporting agency address is: Naval Electronics Laboratory Center NELC, 0200, Office of the Technical Director, San Diego, CA 92152

SUPPORTED BY U.S. Dept. of Defense - Navy

5.0011, SEISMIC AND TECTONIC STUDY OF MEXICO
J.N. BRUNE, Univ. of California, School of Engineering, *San Diego, California* 92038 (EAR76-84060)

This project continues a cooperative program of seismic studies in Mexico. The project is a joint effort of the Universidad Nacional Autonoma de Mexico (Dr. Cinna Lomnitz), the Centro de Investigacion Cientifica y Educacion Superior de Ensenada (Alfonso Reyes) and the University of California, San Diego (Dr. James Brune). The research is important to achieving the goals of the geodynamic project.

Proposed research during the grant period includes: 1) continuation of studies of the Pino Solo earthquake; 2) completion of studies of the Corona blast (30 January 1976); 3) improvement using Rio Hardy station data of location of seismicity in the Colorado Delta area; 4) location of earthquakes and installation of a telemetered seismic station near the Wagner Basin spreading center in the northern Gulf of California; 5) completion of the study of the Canal de Ballenas earthquake.

This is a continuation of NSF Grant EAR74-03188.

SUPPORTED BY U.S. Natl. Science Foundation

5.0012, STUDIES OF ATMOSPHERIC TURBULENCE AND DIFFUSION IN THE SURFACE LAYER
F.H. CHAMPAGNE, Univ. of California, School of Engineering, *San Diego, California* 92038 (ATM76-23856)

The purpose of this project is to complete the analysis of high- frequency velocity and temperature data collected over the East China Sea by the principal investigators during the Air Mass Transformation Experiment (AMTEX) in the winter of 1975. The scientific objective of the analysis is to better understand the micrometeorological and fine scale turbulent features of the atmospheric planetary boundary layer in a region of strong air mass interaction and modification. Such an understanding is the first step in the implicit incorporation of turbulent processes in numerical weather simulation and prediction models. This is necessary because turbulent processes cannot be explicitly accounted for in current numerical weather prediction models.

Specific major goals are to: (1) calculate the fluxes of momentum and heat by several different techniques and compare these fluxes to those obtained from the National Center for Atmospheric Research's (NCAR) Electra data set; and (2) calculate the velocity and temperature dissipation rates.

SUPPORTED BY U.S. Natl. Science Foundation

5.0013, PUBLIC FORECAST & WARNING
J. LEE, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (RC360205)

PROJECT OBJECTIVE: This work requirement addresses a general aviation need for meteorological data on thunderstorms near aircraft as they land and take off. The program calls for direct and indirect turbulence measurements in and below thunderstorm cloud base, primarily along the leading edge of thunderstorm cold-air outflow.

CURRENT YEAR PLAN: Concurrent observations made using Doppler radar and instrumentated aircraft will be used to validate research indicating Doppler radar turbulence signature. In addition, the characteristics of the cold air outflow - gust front - as it relates to aircraft landings and takeoffs will be investigated using an instrumented 444m tower, aircraft, radar, and surface observations.

PROGRESS REPORT; Analyses of penetration and concurrent radar data indicates the potential for the second moment as a turbulence signature. The use of the Doppler in 'clear air' has been highly successful and combined with the recording and analyses of more than 20 gust front cases, is leading to a realistic gust front model development.

SUPPORTED BY U.S. Dept. of Transportation - F.A.A.

5.0014, CONTRACT FOR THE MANAGEMENT, OPERATION, AND MAINTENANCE OF THE NCAR
P. SPYERDURAN, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., *Boulder, Colorado* 80302 (OCE77-02039)

This is an addition to contract C760 to provide for the NCAR Queen Air aircraft operation as a part of the CUEA (Coastal Upwelling Ecosystem Analysis) JOINT-II Experiment off the coast of Peru in 1977.

In this multidisciplinary study, a primary research component is concerned with the measurement and analysis of the meteorological conditions in the marine layer, especially the winds which drive the upwelling. The aircraft will also supply the entire project with synoptic mapping of the important sea surface temperatures in the study area.

SUPPORTED BY U.S. Natl. Science Foundation

5.0015, GLOBAL MAGNETISM - GM
J.C. CAIN, U.S. Dept. of the Interior, Geological Survey, *Denver, Colorado* 80225 (9780-01754)

Definitive computation of geomagnetic field. This will include analysis of Russian and U. S. satellite magnetic data, incorporation of surface magnetic survey data and definition of transient variations due to external causes. Numerical analysis is to be done on both a global scale and by local functions to define the surface field to a scale down to 1 Km.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

5.0016, PETROPHYSICAL STUDIES
K. WATSON, U.S. Dept. of the Interior, Geological Survey, *Denver, Colorado* 80225 (9790-01694)

A petrophysical laboratory has been established to measure the electric, magnetic and optical properties of geologic materials in a variety of environments that will be used to interpret in-hole, ground, airborne, and satellite geophysical measurements. In-

vestigations this fiscal year will focus on spectral reflectances of altered rocks, electrical properties of clay minerals, development of non-linear resistivity technique, and magnetic and electrical properties of rocks in geothermal environments.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

5.0017, OBSERVATIONAL STUDIES OF TROPICAL WEATHER SYSTEMS
W.M. GRAY, Colorado State University, School of Engineering, *Fort Collins, Colorado* 80521 (ATM75-01424 A02)

The objective of this research continues to be the analysis of tropical atmospheric data for theoretical and modelling studies of the dynamics of tropical weather systems and cumulus/cyclone-scale interactions. Specific tasks involve extensive use of the data collected during the Global Atmospheric Research Program's (GARP) Altantic Tropical Experiment (GATE) as well as other, less-detailed tropical data sets. These tasks include: (1) Analysis of tropical cloud clusters for the purpose of modelling their basic features. (2) Hurricane and typhoon studies and modelling. (3) Satellite data studies of deep tropical convection. (4) Tropical cyclone studies. (5) Comparison study between the GATE data and more extensive, but less dense sets of the West Pacific and West Atlantic.

SUPPORTED BY U.S. Natl. Science Foundation

5.0018, STUDIES OF THE FLOW THROUGH THE CARIBBEAN SEA
R.E. YAGER, Nova University, Physical Oceanographic Lab., *Dania, Florida* 33004 (OCE76-20726)

This project will continue and complete the analysis of data obtained from several satellite-tracked drogued buoys. Nineteen buoys were deployed in the Eastern Caribbean Sea in two phases: eight in October, 1975, and eleven in January, 1976. In March, 1976, thirteen buoys were still transmitting; three from first phase, and ten from the second. Hydrographic sections made by the University of Puerto Rico describe currents generally in agreement with the observed westward drift of the buoys. Smaller-scale details of the surface currents may also be evident in both buoy tracks and in the hydrographic data. Tracking will continue until the buoys stop transmitting, disappear, or are picked up. Data from the buoys consists of position, wind speed, and drogue condition as functions of time. Surface velocity charts will be prepared and correlated with satellite-measured sea-surface temperature charts. Statistical techniques will be applied to observed fluctuations in the buoy motions.

SUPPORTED BY U.S. Natl. Science Foundation

5.0019, STUDY AND IMPLEMENTATION OF AN IONOSPHERIC TECHNIQUE TO IMPROVE TSUNAMI WARNING
K. NAJITA, Univ. of Hawaii, School of Engineering, *Honolulu, Hawaii* 96822 (ENV76-15773)

The devastative power of destructive tsunami waves generated by ocean-based earthquakes is well documented. The Alaska earthquake of 1964 generated tsunami waves which caused severe damage throughout the Gulf of Alaska, along the West Coast of North America, and in the Hawaiian Islands. The Chilean earthquake of 1960 resulted in tsunami damage along the shores of South America, parts of North America, the Hawaiian Islands, New Zealand, the Philippine islands, the Japanese Islands, and other areas in and around the perimeter of the Pacific Ocean.

Previous work carried out and published by the investigators has shown that long period Rayleigh waves from large earthquakes excited upward traveling acoustic waves in the atmosphere which in turn produce variations in the ionosphere. These ionospheric motions can be monitored by radio frequency reflection techniques. Rapid analysis of such Rayleigh waves is very promising from the standpoint of evaluating whether a potentially destructive tsunami has been generated by a large earthquake.

The work proposed for this project will be directed toward three principal objectives: 1. Operational tests of an ionospheric tsunami warning system and improvement of the electronic units previously developed. 2. Integration of the system into the Pacific Tsunami Warning System on an experimental basis. 3. Improvement and simplification of the source-mechanism analysis method as a basis for more accurate tsunami prediction data.

SUPPORTED BY U.S. Natl. Science Foundation

5.0020, IONOSPHERIC ELECTRON CONTENT USING MEASUREMENTS OF VHF TRANSMISSIONS FROM GEOSTATIONARY SATELLITES
T.H. ROELOFS, Univ. of Hawaii, School of Engineering, *Honolulu, Hawaii* 96822 (ATM74-13858 A01)

This funds as a supplement measurements of ionospheric electron content using the ATS-6 satellite. The original grant (see GA-43468) funded Faraday rotation measurements of the signal from the ATS-1 satellite, which gives the total electron content between the observer and the satellite. The new measurements, funded here, include both Faraday rotation and group delay. This gives a separate measure of the plasmaspheric electron content, and this extends the usefulness of the data considerably.

SUPPORTED BY U.S. Natl. Science Foundation

5.0021, SYNOPTIC ANALYSIS FOR THE GLOBAL ATMOSPHERIC RESEARCH PROGRAM (GARP) ATLANTIC TROPICAL EXPERIMENT (GATE)
J.C. SADLER, Univ. of Hawaii, School of Arts & Sciences, *Honolulu, Hawaii* 96822 (ATM72-01680 A04)

The objective of this project continues to be the preparation of analyzed charts of meteorological conditions over the tropics during the Global Atmospheric Research Program (GARP) Atlantic Tropical Experiment (GATE). This phase of the work involves the completion of the data collection effort to be followed by the subjective (hand) analyses of daily charts of winds, temperature, pressure heights and moisture over the GATE region. These charts will be compared with mean monthly analyses (already completed under this grant) in order to evaluate the representativeness of the GATE period. In addition, the daily charts will be used to test indirect methods of obtaining meteorological fields, such as wind vectors derived from satellite cloud fields.

SUPPORTED BY U.S. Natl. Science Foundation

5.0022, IDENTIFICATION OF PREFERRED DOUGLAS-FIR TUSSOCK MOTH SITES
R.C. HELLER, Univ. of Idaho, Forest Wldlfe. Exp. Station, *Moscow, Idaho* 83843 (0069829; IDA-ES-0091)

OBJECTIVE: Produce correlative tree, stand and site information from color infrared aerial photographs which identify those factors which contribute to susceptibolity of firs to Douglas-fir tussock moth epidemics.

APPROACH: The color infrared aerial photographs taken in 1974 will be interpreted to do determine at each one-acre plot: level of tussock moth defoliation damage; aspect of plot; slope of plot; height of dominant trees and their age. Simple and multiple regressions will be made along with discriminant analysis techniques to test our hypotheses.

PROGRESS:

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

5.0023, PREPROCESSING AND ANALYSIS OF GEOPHYSICAL REMOTE-SENSING DATA
P.E. ANUTA, Purdue University, School of Engineering, *Lafayette, Indiana* 47907 (ENG76-14400)

The advent of airborne and satellite-borne multispectral scanner systems has resulted in the development of computer-based technology for information extraction from the multivariate image data generated by these systems. This research effort addresses the problem of preprocessing and analysis of geophysical remote-sensing data which carries information on the subsurface nature of the earth rather than surficial phenomena. In part one the problems of transforming image, line, and point data such as from aeromagnetic, gravity, gamma ray, radar, and bore hole sensor sources will be studied to define methods for placing

this data in a uniform multivariate grid format for input to analysis algorithms. In part two research on methods of analysis of the multi-image formats will be conducted with the goals of defining algorithms and analysis steps to transform a sample vector into an information quantity.

SUPPORTED BY U.S. Natl. Science Foundation

5.0024, REMOTE SENSING OF IOWA'S AGRICULTURAL AND FORESTRY RESOURCES

R.E. CARLSON, Iowa State Univ. of Sc. & Tech, Agric. Experiment Station, *Ames, Iowa* 50010 (0064179; IOW01997)

OBJECTIVE: Refine and improve remote sensing-photointerpretation procedures relating to Iowa's natural resources in problems dealing with classification and inventory of agricultural and forest lands and the detection of adverse stresses in these ecosystems.

APPROACH: Standard photointerpretive procedures and new technology, as available, will be incorporated to extract information from existing and proposed aerial imagery to develop classification schemes to inventory soils, crops, forest land and the extent of diseases in crops and trees at selected test sites in Iowa. It is anticipated that the information extracted at test sites can be extended to areas not physically examined on the ground, but covered by aerial imagery. Basically, we hope to consolidate our expertise from different fields to maximize the information with respect to agriculture available from remote sensors.

PROGRESS: Vegetation: A) A winter mosaic of Iowa was constructed from LANDSAT images. Coverage was partially reduced by clouds, but snow cover accentuated forested areas. Topographic features were in evidence in some areas. B) Multispectral, temporal LANDSAT images were digitized at the Remote Sensing Institute at Brookings, South Dakota. These data are being tested for cropland and forestland identification and inventory in central Iowa by automatic computer-assisted techniques. C) Conditions in 1975 were not favorable for stalk rot development in research plots, hence detection was not attempted. Bacterial fire blight in apples, cv. Jonathan, was detected using color infrared photographs when 10% of the vegetative shoots were diseased. D) Brown stem rot (BSR) diseased soybean plants were detected only from specific- angle low-level aerial images. This was not observed before and may have contributed to previous difficulty in consistent BSR detection. Ground truth was obtained for BSR and for cropping sequences in specific high BSR incidence areas in southeast Iowa for the 3rd year. It is now possible to identify each field with BSR for use in the evaluation of BSR resistant lines and for disease control. Soils: A) A comparison of color, color infrared, and black and white panchromatic images as a base for making soil maps is in progress in Johnson County.

SUPPORTED BY Iowa State Government - Des Moines

5.0025, EFFECTS OF STREAM CHANNELIZATION ON THE RIPARIAN COMMUNITY, IOWA

R.B. DAHLGREN, Iowa State Univ. of Sc. & Tech, Agric. Experiment Station, *Ames, Iowa* 50010 (0067911; IOW02085)

OBJECTIVE: Determine short- and long-term effects of channelization on land use practices, and on plant, avian, and mammalian communities by investigating: changes in land-use of old meanders bypassed by channelization, determined using aerial photos of randomly selected townships, composition and structure of the riparian plant communities under pre- and post- channelization, composition and density of avian and mammalian communities under pre- and post-channelization conditions, effects of channelization on breeding ecology of birds and mammals, and correlations between riparian plant communities as affected by channelization over time with resultant bird and mammal populations.

APPROACH: Aerial photos will be used to determine land-use changes and to select representative study areas. Plant communities on study areas will be studied using 32 gridded study plots 800 x 1200 m and 32 subplots 180 x 280 m. Composition and density will be determined for mammals on 180 x 280 m subplots and for birds on 800 x 1200 m plots. Bird and mammal populations will be compared for altered and unaltered segments of streams and correlated to changes in plant communities.

PROGRESS: Pre- and post-channelization aerial photos are being examined for changes in vegetation composition and land use practices associated with channelization. Such documentation is necessary for selection of study areas where bird, mammal, and plant communities will be examined in the future. Data are nearly complete for computer analysis. The aim of this study is to first determine short-term and long-term effects of channelization on land use and vegetation and to then determine effects on wildlife through study at representative sites (control and altered).

SUPPORTED BY Iowa State Government - Des Moines

5.0026, GEOPHYSICAL FLUID DYNAMICS

O.M. PHILLIPS, Johns Hopkins University, School of Engineering, *Baltimore, Maryland* 21218 (ATM76-04050 A01)

This grant is for the continuation of basic research on a variety of processes that are directly concerned with atmospheric phenomena. These include the formation of sporadic patches of turbulence in a stratified fluid as a result of local instability and the mechanism of turbulent entrainment across a density jump. Both of these processes are of importance in clear air turbulence. A second, but closely related area, is the breaking of short surface waves in deep water under the influence of wind; the turning under of the water surface and the small-scale mixing certainly influences strongly and probably dominates in some cases the interfacial heat and water vapor transfer. These processes underlie the parameterization needed in long-range numerical weather prediction. Another research area in which studies will be continued is the stability of time-dependent flows in a continuously stratified atmosphere. In particular, the stability of propagating internal waves and the stability of horizontal and vertical boundary layers will be further investigated. In these cases, there are profound dynamical differences from the corresponding quasi-steady and the unstratified situations.

SUPPORTED BY U.S. Natl. Science Foundation

5.0027, PCM TELEMETRY AND CC FOR BALLOONS

A.A. GIANNETTI, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF248870)

AF function - advanced balloon systems (surveillance, reconnaissance, communications, environmental research support). Deficiency - existing instrumentation systems do not meet control and telemetry requirements for proper evaluation of AF payloads. Objectives - design, develop, and test hardware and software for balloon PCM flight systems to provide real-time data decommutation and manipulation through the use of a minicomputer. How research contributes - the new instrumentation will provide the necessary accuracy and format for the proper logging and display of vital scientific data essential for proper evaluation of AF scientific balloon-borne payloads.

An existing PDP11/40 computer will be interfaced with a PCM ground station and a software program will be developed for data handling, logging and manipulation. An airborne PCM system will be developed in- house to meet most scientific technical requirements and used to verify and evaluate the overall system capability. A contract will be utilized to support this work, both for component fabrication and for interface, installation and software development.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LC, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0028, ALTITUDE PROFILE OF NEUTRAL THERMOSPHERIC COMPOSITION AND DYNAMICS

W.K. VICKERY, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF248950)

AF function - operate missiles and satellites in and through the upper atmosphere. Opportunity - the DMSP supplementary sensor density package (SSD) requires calibration in order to assure accurate global measurements of atmospheric density. Objective - measure the density profile of major neutral atmospheric species with near-simultaneous measurements of the dynamical structure of the region between 90 and 180 kilometers. How research contributes - provides profile of major neutral species,

turbopause altitude and thermospheric temperature profile needed as inputs for the calibration of the DMSP(SSD) package.

Each set of measurements involves two rocket payloads. One payload contains a specially designed neutral mass spectrometer to measure the density of each of the major atmospheric species. The other will dispense a vapor trail for dynamics measurements (including eddy diffusion coefficients, molecular diffusion and turbopause altitude data and temperature measurements). These measurements are combined with measurements of solar UV absorption, electron energy distribution and airglow radiation for a set of essential inputs to support the SSD calibration. The data are collected from the mass spectrometer by telemetry and reduced in terms of the neutral species distribution. Atmospheric dynamics parameters are determined from analysis of time lapse photographs of vapor trails yielding wind, wind shear and temperature profiles, diffusion coefficients, and indirectly, total neutral density. Two sets of measurements are planned, one in FY77, a second in FY78.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LK, L.G. Hanscom AFB, Bedford, Mass. 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0029, INFRARED ATMOSPHERIC MODEL

T.C. DEGGES, Visidyne Incorporated, *Burlington, Massachusetts* (DF248580; F19628-77-C-0041)

AF function - direct support of Air Force rocket, satellite and aircraft programs. Deficiency - lack of knowledge of infrared atmospheric backgrounds. Objective - contract is to develop and improve models of the infrared transmission and radiance of the earth's atmosphere. How research contributes - will provide information on infrared atmospheric backgrounds required for carrying out AF functions.

Infrared atmospheric models will be developed to determine the radiance and transmission of the earth's atmosphere for both equilibrium and non-equilibrium conditions. The models will be compared and tested against the latest rocket and satellite data to determine where improvements in the models can be made.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory OP, L.G. Hanscom AFB, Bedford, Mass. 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0030, STUDIES OF THE SEASONAL VARIATION OF THE THERMOSPHERE WIND SYSTEM

R.E. NEWELL, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (ATM76-22279)

This grant funds a study of the diurnal and seasonal variation of the winds in the thermosphere. The data-analysis entails fitting two- dimensional polynomial series to raw measurements of electron density, electron and ion temperature and vertical velocity to obtain smooth analytical descriptions of these parameters as functions of height and time. From these functions the time variation of the exospheric temperature and meridional component of the neutral wind were obtained. The pressure force, expressed in terms of the latitudinal and longitudinal variation of the exospheric temperature that will reproduce the measurements is then sought using a dynamical model of the neutral thermosphere. From this the meridional and zonal winds which are self- consistent and consistent with the measured ion drag for each day are obtained. The study is expected to test present ideas concerning the interhemispheric transport of gases lighter than N2 (e.g. He and O) at solstice and the importance of heat deposited in the auroral zones by particle precipitation and electric currents.

SUPPORTED BY U.S. Natl. Science Foundation

5.0031, STRUCTURE OF THE UPPER ATMOSPHERE

J.M. FORBES, Boston College, Graduate School, *Chestnut Hill, Massachusetts* 02167 (DF047160; AF-AFOSR-3223-77)

AF function - variations in neutral atmospheric structure are of importance to satellite and missile design and generation, and have important effects on communications systems. For instance, satellite ephemeris prediction, missile trajectory prediction, missile plume simulations and computer simulation of nuclear blast effects are operational problems which are affected by neutral atmosphere structure. Deficiency - in spite of progress made in the area of atmospheric physics, a sufficiently accurate model of the neutral atmosphere does not exist. Theoretical research in the area of thermospheric structure is needed to explain variations in density and composition data from recent satellite experiments which disagree in some respects with incoherent scatter data. Objective - the purpose of the proposed research is to perform theoretical numerical solutions of the quiet and magnetically disturbed upper atmosphere, and to determine the consistency of the results to available and incoherent scatter data. Contribution - an improved model of the neutral upper atmosphere will provide a better theoretical base for predicting missile trajectories and satellite drag and will contribute to improved models of changing ionosphere and communication effects.

This work will involve using previously developed computer programs for solving the complete, coupled, inseparable momentum, continuity, and thermodynamic equations for the quiet-time thermosphere, and an f-plane approximation to the full three-dimensional model. These programs will be used to study seasonal variations in thermospheric tides, mode- coupling effects on thermospheric tides, the super-rotation mechanism, and possibly composition variations. Proposed study of the magnetically-disturbed atmosphere primarily involves development of a time-height- latitude-longitude model of the response to a localized, transient, heat source. Ion draft acceleration will also be included as a momentum source during magnetic disturbances.

ADDENDA: Supporting agency address is: Af Office of Scientific Research NP, Bldg 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0032, EVALUATION OF URBAN TREE VIGOR FROM COLOR AND COLOR-IR AERIAL PHOTOGRAPHY

C.E. OLSON, Univ. of Michigan, School of Natural Resources, *Ann Arbor, Michigan* 48104 (0070637; MICY00092-F)

OBJECTIVE: Determine whether declining vigor in urban trees can be detected from medium-scale, color and color-IR air photos, and assess consistency with which declining tree vigor can be determined from color and color-IR air photos by different photo-interpreters.

APPROACH: Prior work under Project MICY-F037 provides substantial information on symptoms of maple decline, and a population of identified urban maple trees whose symptoms have been determined from ground observations. Color and color-IR air photos at a scale of 1:8,000, obtained on July 4, 1975, are available for the study area. Four sample areas have been identified. Twelve image interpreters will examine the photography stereoscopically and record any symptoms of tree stress observed within each test site. Results will be compared with 1975 ground assessments of these same trees to determine accuracy and consistency of photo assessments of maple decline. Work can be expanded to other species and causes of vigor decline.

SUPPORTED BY Michigan State Government - Lansing

5.0033, IDENTIFYING AND MONITORING SELECTED FLOODPLAIN CHARACTERISTICS

J.H. SHAMBURGER, U.S. Army, Waterways Experiment Station, *Vicksburg, Mississippi* 39180 (31014)

OBJECTIVES: The objective of this study is to determine the utility of LANDSAT to monitor changes in selected floodplain characteristics: (1) Wetlands including extent and duration of flooding. (2) Present and potential land utilization. (3) Physical characteristics such as river channel changes, areas of erosion and deposition, and flood-susceptible areas.

APPROACH: This investigation will utilize the spectral signatures of floodplain environments to determine pedological, vegetative, morphological, and hydrological characteristics that are pertinent to environmental control of physical or cultural changes. The study will be conducted in a selected portion of the Mississippi River floodplain where extensive ground-truth data and historical imagery are available. As a result of the spring 1973 and spring 1975 floods, considerable changes in the river regime have taken place. Pre-, during, and postflood LANDSAT and aircraft imagery is available.

Three distinct subareas have been selected for intense study. Subarea 1 was selected for its representativeness of land use and

floodplain environments of deposition (point bar, backswamp, abandoned channels and courses, and braided stream). Flooding from stream overflow within this subarea has been minimized through channel improvement of the major drainageway coupled with the artificial levee system along the Mississippi River. Subarea 2 includes a good example of a segment of the Mississippi River within the confines of the artificial levee system. Overbank flow occurs within this subarea when the river stage reaches 48 ft at the Greenville, Miss., gauge. Land use will also be inventoried. Subarea 3 is one of the few areas outside the artificial levee system that is subject to widespread flooding in this part of the alluvial valley. Flooding in this subarea is directly influenced by the Mississippi River because the stage on the Mississippi affects the flow of the Yazoo River.

The LANDSAT-2 aircraft and selected LANDSAT-1 images will be examined to determine the ability to identify land-use patterns, environments of deposition, and areas of wetland (standing water or high moisture content). This examination will be accomplished by examining the imagery representing individual bands. (Text Abridged)

SUPPORTED BY U.S. Dept. of Defense - Army

5.0034, THE USE OF AN X-BAND RADAR AT PALMER STATION FOR STUDIES OF ATMOSPHERE-OCEAN INTERACTIONS

J.A. WARBURTON, Univ. of Nevada System, Desert Research Institute, *Reno, Nevada* 89507 (DPP76-17501 A01)

A gamma-cm wavelength weather radar system will be installed at Palmer Station during the austral summer of 1976/77 to study the effect of the mountain barrier on air mass motion, the effect of katabatic and foehn winds on near-shore ice movement, and low-level convective elements associated with precipitation. The recorded radar images will also supply 'ground truth' for satellite measurements which are used extensively on other Antarctic meteorology projects supported by NSF/DDP.

Logistics support is required for three scientists to visit Palmer Station during the austral summer of 1976/77 for the radar installation and for one winter-over scientist during 1977.

SUPPORTED BY U.S. Natl. Science Foundation

5.0035, TSUNAMI NETWORK SUPPORT

H.E. CLARK, U.S. Dept. of the Interior, Geological Survey, *Albuquerque, New Mexico* 87106 (9920-01263)

STATES TO WHICH PROJECT PERTAINS: New Mexico and California.

The objectives to be sought in the current fiscal year are to operate Tsunami Tide Systems and the Tsunami Seismic Systems over the GOES SMS satellite network. The Tsunami Tide Systems will be operationally evaluated in an actual NWS facility located in San Diego, California. The Tsunami Seismic Systems will be operationally evaluated in a realistic system configuration at the Albuquerque Seismological Laboratory, Albuquerque, New Mexico. Various parameters in the event detection and validation unit will be tested for optimum event detection for various types of earthquakes as to size and distance from the Tsunami Seismic System.

Each microprocessor type Tsunami Tide and Tsunami Seismic System will be operated over the GOES SMS Satellite Network and the NASA Landsat Satellite Network.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

5.0036, DISTURBED ATMOSPHERIC MEASUREMENTS PROGRAM

D.E. SNIDER, U.S. Army, Atmospheric Sciences Lab., *Las Cruces, New Mexico* 88002 (DA0D2299)

The technical objective is to measure the response of atmospheric constituents and properties to various natural disturbances in order to validate the physical and chemical models utilized by atmospheric effects codes. Section 9 of the Army Qualitative Research Requirements for nuclear weapons effects information (AQRR) documents the requirements for this work in connection with communications and ballistic missile defense.

Field measurements utilizing ground-based, balloon-borne, and rocket-borne sensing will be conducted during natural disturbances in the middle atmosphere. Insofar as possible, simultaneous measurements of several atmospheric constituents and properties will be made. The measurements will be integrated into coordinated field programs of other agencies. The results will be utilized by the in-house work unit, 'Modeling of Disturbed Atmospheres.'

ADDENDA: Supporting agency address is: ECOM Atmospheric Sciences Laboratory, DRSEL-BL-D, White Sands MR, NM 88002

SUPPORTED BY U.S. Dept. of Defense - Army

5.0037, BRUSHFIELD ANALYSIS OF CLEARCUTS USING MULTI-BAND STEREOSCOPIC AERIAL PHOTOGRAPHY

D.P. PAINE, Oregon State Higher Educ. Sys., School of Forestry, *Corvallis, Oregon* 97331 (0066739; ORE-F-00963)

OBJECTIVE: Feasibility of brushfield identification as to species composition and density for the purpose of analyzing coniferous regeneration problems using aerial photography.

APPROACH: There are four distinct phases of this proposed research. Phase I will consist of determining the optimum single or multi-band film-filter combinations using inexpensive 2 1/4 x 2 1/4 inch terrestrial photography. Phase II will utilize aerial photography to test one or more of the best film-filter combinations as determined in Phase I at a minimum of two different photo scales. Phase III will consist of obtaining ground truth of the test sites as photographed from the air, both as to brushfield conditions and coniferous regeneration present. Phase IV will consist of developing a sampling system for brushfield inventory--complete with implications as to regeneration survival and potential--coupled with an economic analysis to optimize the system.

PROGRESS: Ten permanent plots have been established and photographed using various film-filter combinations for different seasons of the year. At present the color infrared emulsion appears best for brush species identification, but the multi-spectral analysis is incomplete. A local contractor is working on a 35 mm camera system that we plan to use for spring photography. This should reduce costs so that the expected large-scale photo requirement may be economically feasible for practical application. This small film format, coupled with the large-scale photography requirement, will make it necessary to develop a sampling system.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

5.0038, D-REGION STUDIES AT THE ARECIBO AND IONOSPHERE RESEARCH LABORATORY FACILITIES

A.J. FERRARO, Penn. State University, Ionosphere Research Laboratory, *University Park, Pennsylvania* 16802 (ATM76-14277 A01)

This grant funds an experimental program to perform D-region measurements with a radio-wave interaction experiment. These experiments will be done primarily at the National Astronomy and Ionosphere Center at Arecibo, Puerto Rico, in conjunction with an ionospheric heating experiment at the incoherent-scatter radar there, and with an assemblage of other radio and optical experiments. This will allow a comprehensive set of data to be obtained so that the various experiments can be compared with each other. The primary measurements to be made under this grant are electron densities in the 55-100 km region. These data will be used to study the effects of radio-wave heating in the ionosphere, the D-region winter anomaly, and the ion chemistry of the D region. Particular attention will be paid to cross-verification of the various experimental techniques, and to use the data along with models of the chemistry to try to establish bounds on some of the species concentrations in the mesopause.

SUPPORTED BY U.S. Natl. Science Foundation

5.0039, EXTENSIVE D-REGION STUDIES AT ARECIBO

A.J. FERRARO, Penn. State University, Ionosphere Research Laboratory, *University Park, Pennsylvania* 16802 (ATM76-82453)

This grant funds an experimental study of the D region of the ionosphere to be conducted at the National Ionosphere and Astronomy Center at Arecibo, Puerto Rico. Detailed measurements will be made of electron densities as a function of time and altitude in the 50 to 100 km region. These observations will provide effective electron recombination coefficients, information about D-region ledge with 600 meter resolution, detailed study of D-region metallic ions and will provide a basis for incoherent scatter spectral studies of the D region. D-region electron density measurements will be made simultaneously at Arecibo and Pennsylvania using the cross-modulation facilities at Pennsylvania State College during quiet conditions and during solar x- ray flare events. This provides a unique opportunity to examine the midlatitude and tropical D-region physics.

SUPPORTED BY U.S. Natl. Science Foundation

5.0040, SETTLEMENT SURVEY IN THE BASIN OF MEXICO - NEW METHODOLOGICAL APPROACHES
W.T. SANDERS, Penn. State University, School of Liberal Arts, *University Park, Pennsylvania* 16802 (BNS76-83070)

The central Mexican plateau is one of the key regions of the world in terms of a major research objective of anthropology definition of the factors and understanding of the processes that led to the evolution of complex societies. It was here that the earliest development of agricultural subsistence in the New World occurred, and it was a major center of development of the early stages of the civilizational process. Between 1960 and 1965, several Mexican and American anthropologists undertook a massive survey which was intended to cover the entire Basin of Mexico, an area of 7,000 square kilometers. Most has now been done, but problems persist. One of these has to do with the impossibility of detecting subsurface cultural remains from surface surveys. The present research will utilize new technology--the use of aerial infrared photography--to test a new hypothesis--namely, that areas of deep soil were indeed inhabited even though no remains are to be found on the surface. Since these areas are known to be among the most fertile today, it seems strange that they should have been avoided during Classic times, as it would appear from the original survey.

SUPPORTED BY U.S. Natl. Science Foundation

5.0041, LIDAR ATMOSPHERIC MEASUREMENT PROGRAM
K.T. PETRI, U.S. Navy, Aero Electronic Tech. Dept., *Warminster, Pennsylvania* 18974 (DN681244)

To investigate the feasibility of utilizing a lidar to remotely measure radio electrooptical properties of the atmosphere.

Lidar techniques will be tested and evaluated to determine the optimum method of remotely measuring the radio refractive index and electrooptical properties of the atmosphere. Measurement precision will be equal to or greater than that of existing radiosonde methods. Some work is also planned on contracts as reported in work unit RG702 B.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Tech Admin (Surveillance), Washington, D.C.

SUPPORTED BY U.S. Dept. of Defense - Navy

5.0042, INVESTIGATION OF ELECTRON PRECIPITATION ASSOCIATED WITH VLF ACTIVITY AT SIPLE STATION, ANTARCTICA
W.R. SHELDON, Univ. of Houston, School of Arts & Sciences, *Houston, Texas* 77004 (DPP76-22135)

It is proposed to complement the already intensive campaign to investigate magnetospheric wave-particle interactions at Siple Station in the austral summer 1977-78 through addition of an X-ray flux experiment. The measurements will be made with a parachute deployed X- ray detector which has been launched to approximately 85 km (above 1 gm/cc atmospheric thickness) aboard a Super Arcus rocket. About 15 minutes of data will be obtained from altitudes above 30 km. The X-ray measurements will provide flux and spectra information about trapped particles (electrons) precipitated as a result of wave-particle interaction.

Rockets will be launched at times when VLF activity indicates that an interesting event, natural or artificially stimulated, is in progress. Similar measurements have been made from 30 km altitude but artificially precipitated electrons have not been detected. It is expected that the Siple VLF transmissions may precipitate electrons at lower energy than can be observed at 30 km; they simply do not penetrate to that depth. The technique proposed will place the detectors at an altitude where the lower energy electrons (approximately 5kev) can be detected. Another advantage of this technique is that it is wide angle and inspects a large region. The results will be compared with measurements made at approximately 210 km to deduce the size of the precipitation ducts along which emissions propagate. The results will provide a more accurate estimate of the constant used to relate an observed X-ray spectrum to the parent electron spectrum.

Results will be correlated with that from Nike Tomahawks (150- 250km), balloons (30km), ground-based detectors and with previous results from the same geomagnetic latitude but different geographic latitude. The last comparison will be made to see if position with respect to the solar wind leads to different results.

SUPPORTED BY U.S. Natl. Science Foundation

5.0043, FOREST TYPE MAPPING OF THE ATCHAFALAYA RIVER BASIN FROM SATELLITE AND AIRCRAFT IMAGERY
R.D. BAKER, Stephen F. Austin State Univ., School of Forestry, *Nacogdoches, Texas* 75961 (0067127; TEXY-74-031)

OBJECTIVE: Develop a forest cover type mapping system compatible with ERTS-1 multispectral scanner imagery, NASA RB-57 1:120,000 scale imagery and SKYlab photographs. Delineate the Atchafalaya River Basin forest cover types from ERTS-1 imagery, RB-57 1:120,000 scale photography and SKYlab photography and prepare semicontrolled maps of the delineated river basin. Verify delineated forest cover types by means of a multi-stage sampling design. Evaluate ERTS-1 imagery, RB-57, and SKYlab photography for suitability as data for forest cover type mapping.

APPROACH: Develop a forest cover type mapping system for the basin. Delineate and map the basin forest cover types from available imagery. Verify delineated forest cover types by four test strips of underflight photography and random ground truth check. Multistage statistical verification and subjective evaluation of relative merits for forest cover mapping of wetlands will be performed.

SUPPORTED BY Texas State Government - Austin

5.0044, THEORETICAL INVESTIGATIONS OF PLASMA AND NEUTRAL GAS TRANSPORT PROCESSES IN THE IONOSPHERE
R.W. SCHUNK, Utah Higher Education System, Graduate School, *Logan, Utah* 84321 (ATM76-19792)

This grant, a continuation of National Science Foundation Grant ATM 7422343, funds theoretical investigations of the effects that plasma and neutral gas transport processes have on the ionosphere and atmosphere. In particular, the Principal Investigator will (1) calculate diffusion and thermal conduction equations for the mid-latitude ionosphere that contain thermal diffusion and thermoelectric effects (2) calculate auroral ion velocity distributions for nonresonant ion-neutral interactions, (3) calculate polar wind density, temperature and drift velocity profiles with allowance for heating due to convection electric fields (4) calculate density, temperature and drift velocity profiles for He ion in the polar wind, (5) obtain a numerical solution of the complete 13-moment system of transport equations for polar wind conditions and (6) obtain a numerical solution of the 13-moment system of transport equations for the neutral atmosphere.

SUPPORTED BY U.S. Natl. Science Foundation

5.0045, REMOTE SENSING IN AGRICULTURE
N.L. POWELL, Virginia Poly. Inst. & St. U., School of Agric. & Life Sci., *Blacksburg, Virginia* 24061 (0065075; VA-0312724)

OBJECTIVE: Use multi-spectral sensing techniques identify plant canopies of various stages of development, determine plant vigor, evaluate plant communities for effects of plant stress, determine the optimum wavelength regions for specific signatures of crop and soil conditions, utilize data processing devices, including computer software, analyze data and provide appropriate maps and other results, develop a system of remote sensing useful for agriculture.

APPROACH: Utilizing aerial platforms, remote sensing overflights with camera and multi-band sensor systems will be conducted on controlled agricultural experiment stations and farms in the Chesapeake Bay region. Detailed ground-truth data of soil and crop parameters will be correlated with the multi-spectral imagery.

PROGRESS: Aerial imagery of the southern portion of Southampton County, Virginia was evaluated to determine the spectral, spatial and temporal characteristics of Sclerotinia blight and Cylindrocladium black rot disease in peanut (Arachis hypogaea L.) fields. Natural color and false color infrared imagery were used in the aerial surveys. For Sclerotinia blight, disease detection was best using false color infrared imagery at altitudes up to 19,803m above ground level. Cylindrocladium black rot was easily detectable on either false color or natural color imagery at altitudes up to 19,803m above ground level. With their unique spectral/spatial signatures these diseases were easily distinguishable from other diseases of peanuts. Disease patterns which were difficult to observe from the ground were easily detected with aerial photography. Detection of the diseases by aerial surveys will permit prompt control measures to minimize spread of the diseases. Information from these studies will provide permanent records that can be used to monitor the change in extent and severity of the diseases in future growing seasons.

SUPPORTED BY Virginia State Government - Richmond

5.0046, DEFT DEVICES FOR TERRAIN DATA ANALYSIS AND FEATURE EXTRACTION

J.F. HANNIGAN, U.S. Army, Theoretical & Appl. Phys. Ctr., *Fort Belvoir, Virginia* 22060 (DA0N8067)

To determine the potential of direct electric Fourier transform (DEFT) devices for the extraction of terrain data from aerial photography or other remote sensor output (e.g., radar, IR).

Since the output of DEFT devices is an A.C. signal which contains phase as well as frequency information, the approach will be to determine the information content that can be obtained from both phase and frequency data. Special emphasis will be placed on determining any unique characteristics (both phase and frequency) which could be used to recognize terrain features. All electronic signal processing and analysis techniques (e.g., filters, spectrum analyzers, etc.) for the selection, identification and transmission of the desired information will be included. A program which includes theoretical and experimental investigations is planned. Contact with leaders in DEFT fabrication technology is planned. A report will be written.

ADDENDA: Supporting agency address is: OCE ETL Center for Theoretical & Applied Physical Sciences RI, Ft. Belvoir, VA. 22060

SUPPORTED BY U.S. Dept. of Defense - Army

5.0047, MAGNETIC ANOMALIES FROM SATELLITES

R.D. REGAN, U.S. Dept. of the Interior, Geological Survey, *Herndon, Virginia* 22092 (9780-00371)

The principal objective of this project is the identification and interpretation of magnetic anomalies having geological significance in satellite measurements. Anomalies of such a broad scale could provide information on local, regional, and global crustal structure. Such an analysis of satellite magnetometer data requires development of new analytical techniques that will also have direct application to more standard magnetic surveys, e.g., aeromagnetic data. Such techniques include development and evaluation of geomagnetic field models for use in regional-residual separation; reduction of survey data to a common plane by the equivalent source technique; calculation of magnetic anomalies due to bodies in an inducing field that varies in magnitude and direction; and general problems of the analysis of potential field data on a sphere.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

5.0048, POTENTIAL ENERGY IN THE EARTH'S CYCLOGENETIC REGIONS DURING DIFFERENT WEATHER REGIMES

L.H. HORN, Univ. of Wisconsin, School of Natural Sciences, *Madison, Wisconsin* 53706 (ATM76-22200)

This research proposes to study the physical characteristics of the earth's surface and atmosphere in the principal extratropical cyclogenetic regions of the earth during various weather regimes. The importance of the cyclone scale and the cyclogenetic process in the atmospheric energy cycle is emphasized. Although there is a definite preference for cyclogenesis to occur in certain geographical areas, particularly along the east coasts of Asia and North America, the location, frequency and intensity of the cyclogenesis varies depending on the weather regime. The question is raised as to whether changes in the large-scale regime are responsible for variations in the pattern of cyclogenesis or whether changes in the surface characteristics (sea surface temperatures, snow cover etc.) alter the pattern of cyclogenesis which in turn forces changes in the large-scale flow. Quantitative evaluations of the surface and atmosphere during widely differing regimes may contribute to an understanding of this fundamental question. Attention is focused on the generation of available potential energy in the cyclogenetic regions during the different weather regimes. The need for employing the proper form of the generation equation is emphasized, for if the approximate form is used the effect of the transfer of energy from the surface to the atmosphere on the generation is misrepresented. Data gathered during the Air Mass Transformation Experiment of GARP and indirect satellite soundings would be used to supplement the conventional data.

SUPPORTED BY U.S. Natl. Science Foundation

5.0049, PRECIPITATION MEASUREMENT BY MICROWAVE RADIOMETRY

J.A. WEINMAN, Univ. of Wisconsin, School of Letters & Science, *Madison, Wisconsin* 53706 (ATM75-21117)

The goal of this research is to define the characteristics of a microwave radiometer system that may be used to measure remotely precipitation over sea and land from a satellite. Microwave radiation emitted by precipitation is a function of the density, phase and size distribution of the hydrometeors as well as the horizontal extent and vertical distribution of the hydrometeors. Because these factors are intermeshed, the research effort will attempt to determine the sensitivity of microwave brightness temperature for each of these parameters. The research will consist of a theoretical effort and an experimental effort. The theoretical part will consist of a set of systematic calculations to evaluate the absorption and scattering for spherical hydrometeors, the effect of multiple scattering in inhomogeneous clouds and the effects of the finite horizontal extent of columnar clouds. The experimental part will consist of a series of microwave brightness measurements obtained from aircraft-borne radiometers. These measurements will be obtained at several wavelengths and polarizations and will be used to check the validity of the theoretical work.

SUPPORTED BY U.S. Natl. Science Foundation

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, PLATFORM MOTION REQUIREMENTS FOR INITIAL TRAINING OF AIR-TO-AIR COMBAT SKILLS

L.D. POHLMAN, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF223230)

To determine the effectiveness of platform motion for the initial training of F4 air-to-air combat skills and to determine whether the onset cues provided by the synergistic six-post system on the simulator for air-to-air combat (SAAC) enable transfer of skills to performance in the aircraft.

The incremental training value of simulator platform motion will be determined through the application of a transfer of training paradigm. In the event that onset motion cuing has an incremental transfer effect, students training using platform motion should perform significantly better in the airplane than students trained without platform motion. To make this assessment, three groups are required: (1) students trained in the simulator who receive onset cuing provided by platform motion, (2) students trained in the simulator who do not receive onset platform motion cuing, and (3) students who do not receive any simulator training. The third group is necessary to establish that transfer from the simulator to the aircraft has occurred. The research effort will include the following tasks: (a) selection of air combat maneuvers where motion cues could play a vital role and the development of performance measures for those chosen, (b) development of a syllabus for training these fighter maneuvers, (c) evaluation of the effects of platform motion in terms of transfer of training to the aircraft using student pilots, and (d) evaluation of the effectiveness of the training provided.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory FT, Williams AFB, Arizona 85224

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0002, MUTAGEN AND ONCOGEN STUDY

D.J. BRUSICK, Litton Bionetics Incorporated, *Kensington, Maryland* 20795 (DF320060; F33615-76-R-0515)

The 6570 AMRL has been investigating the oncogenic potential of certain missile propellants in order to more safely use such compounds in a manner dictated by good industrial hygiene and industrial medical practice. In order to set other than 'zero' standards for exposure criteria, it is necessary to obtain as much information on a suspect oncogen as possible including mechanisms of action and relative potency. The specific objective of this research is to use a series of oncogenic and mutagenic procedures in a manner which will present data on the relative potential of the compounds studied to produce tumors in higher order species.

The contractor shall perform a series of experiments to evaluate the mutagenic potential of 1,1-dimethylhydrazine, methylhydrazine and n- phenyl-alpha-napthylamine. The three compounds will be tested in an in vitro microbial with and without metabolic activation (microbial plate test). They will be tested also using an in vitro forward mutation study with cultured mammalian cells and in a system using unscheduled DNA synthesis using human diploid cells. Lastly, the three compounds will be placed in a subacute dominant lethal assay with mice as the indicator organism. In addition, with methylhydrazine only, the rat as well as the mouse will be used as the indicator organism.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab TH, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0003, HELMET-MOUNTED DISPLAY PROTOTYPE DEVELOPMENT

D.W. ANDERSON, U.S. Air Force, Human Resources Laboratory, *Dayton, Ohio* 45433 (DF228220)

To develop a prototype helmet-mounted, virtual-image display system. Current virtual-image visual display systems for ground-based simulation rely on large, expensive optical elements to provide an image and a mosaicked configuration to provide a wide field-of-view. The helmet-mounted display has the potential to reduce costs due to its small size. It will also conserve image generation resources, since only the portion of the scene in front of the pilot's eyes need be generated.

On 1 Oct 76, AMRL will initiate a program to develop a Visually Coupled Airborne Systems Simulator (VCASS). AFHRL/AS will participate with AMRL in the development of the helmet-mounted display which is part of the VCASS program. A prototype helmet-mounted display system will be jointly developed. Since VCASS is intended for engineering applications, it is expected that further work by HRL will be required to develop the potential of the helmet-mounted display system for visual simulation applications. Milestones: initiate development of improved components, 1 Oct 76, demonstration of visually coupled system as hemisperical HUD, 1 Mar 77, VCASS demonstration for air-to-ground, 1 Jan 78, VCASS demonstration for air-to-air, 1 Dec 78, full VCASS demonstration, 1 Jun 79, AFHRL 6.3 effort initiated, 1 Oct 79.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory ASM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0004, VCASS LABORATORY SYSTEMS DESIGN/INTEGRATION

T.A. FURNESS, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321150)

To perform the systems analysis and design of the overall Visually Coupled Airborne Systems Simulator (VCASS), including the visually coupled systems (VCS) components (helmet-mounted sight/helmet-mounted display), scene/graphics generators, and crew station, computational, software data base subsystems. To specify the configuration of VCS and scene generation components to be developed on contract. To integrate these components into a laboratory systems demonstration of the VCASS concept. The ultimate product of this program will be an extremely cost- effective, high-fidelity visual scene simulation capability to be utilized for engineering design as well as training applications. This effort supports afsc development goals tc-2, tc-4, tc-5, ms-4, and tn-1.

The overall VCASS effort will exploit the unique capabilities of the visually-coupled system (helmet-mounted sight/display) technology in order to provide a self-contained ground/airborne man-in-the-loop visual display scene simulator for performing man-machine interface design and engineering of cockpit control/display subsystems. Initially, an interim laboratory demonstration capability will be developed by integrating existing helmet-mounted sight and display components into a cockpit mockup with an interface to a programmable symbol generator. A demonstration will then be performed to show the conceptual use of the VCS as a hemispherical heads-up display. Psychophysical studies will be conducted to determine the critical VCASS design factors such as the required instantaneous field-of-view of the helmet-mounted display, display update rate, angular resolution/update rate of the helmet- mounted sight and trade-off between monocular versus binocular display viewing. As a result of these findings, advanced VCS components will be specified and developed through separate contractual efforts. Simultaneously, a comprehensive systems analysis and system design will be performed for developing an advanced laboratory demonstration of the VCASS concept.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab HE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0005, CONSULTATION ON TOXIC ECOLOGICAL EFFECTS AND ENVIRONMENTAL IMPACT

R.C. INMAN, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF320480)

The objectives of this effort are: (1) To assist users of Air Force chemicals with interpretation of data related to the ecological aspects of their operations, (2) To lend technical assistance and provide professional advice to organizations preparing environmental impact statements or assessments, (3) To assist the Surgeon General in responding to requests for review of criteria documents from NIOSH and EPA, and (4) To maintain contact with academic institutions, industry, and other governmental agencies in order to keep abreast of the state- of-the-art in environmental research.

To provide technical and professional advice to any Air Force organization preparing environmental impact statements or assessments when chemical pollution is a major concern. Close liaison will be maintained with EPA to keep abreast of environmental quality standards and criteria requirements. When The National Academy of Sciences establishes its board on environmental quality, continuous contact will be established for assistance in setting environmental quality standards.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch. Lab TH, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0006, BIODYNAMIC ENVIRONMENTS FOLLOWING CANOPY LOSS
W.F. KENDALL, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF322350)

Due to the unique one-piece construction of the F-16 canopy, the pilot will be exposed to an unknown cockpit flow condition following canopy loss. However, the high degree of pilot acceptance makes this type of canopy a likely choice in future USAF aircraft. A definition of the cockpit flow conditions and their effect on the capability of the pilot to recover the aircraft is the objective of this work unit. This question is an open safety item of the F-16 and should be answered prior to full-scale production of the F-16 or any future aircraft with similar canopies.

A review of windblast literature and operational canopy loss data will be accomplished. AMRL will design and conduct a human test in the NASA Ames 40 x 80 ft wind tunnel. To simulate the cockpit environment following canopy loss at lower speeds, USAF pilots will be seated in an open F-16 forebody mounted in the tunnel. The subjects will perform a tracking task and a subjective evaluation of the environment up to 200 knots tunnel speed. Measurements of the cockpit flow conditions will be made. The factors limiting pilot control will be defined and quantified. The need for additional pilot protection will be determined.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0007, QUANTIFICATION OF VISUAL PERFORMANCE
S. MACLEOD, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF320910)

To provide basic psychophysical and electrophysiological data for evaluation of display parameters on sensory processing of information. To define and exploit the sensory processing capabilities of the peripheral visual field. To develop psychovisual channel capacity measures relatable to electronic display capacity measures. To develop threshold and suprathreshold describing functions of the visual system for both monochrome and chromatic information. To relate psychophysically derived data to characteristics of the visual evoked response (VER) waveform. To define the sensitivity of both steady-state and transient VERs to degraded display conditions. Specific products of this effort are used in other task elements to establish display design criteria and performance requirements for target acquisition, weapon delivery and optical countermeasure applications. Products of this work unit support AFSC development goals TC-1, TC-7, C3-3, and MS-4.

A 5-channel Maxwellian view optical system will be used to precisely control stimulus parameters. The visual response lab will be used for on-line collection and analysis of VER data. Equipment required to control parameters of peripherally presented information will be developed and incorporated into the visual response lab. Initial experiments will provide suprathreshold just noticeable differences (JNDs) as a function of spatial frequency. These will provide the basic data to permit scaling of ordinate axis values on graphs of unitary image quality measures. Threshold describing functions will be generated as a function of waveform (sine and square), adaptation level, color, and orientation of gratings. These data will be used to define a 'standard observer' threshold describing function to be used in unitary image quality measures. Isocontrast describing functions (or families of suprathreshold describing functions) will be developed and applied to unitary image quality measures to determine which best correlate with operator performance. Correlations between VER characteristics and suprathreshold psychophysical data will be established in an attempt to simplify the collection of describing function data. Target-to- background contrast (in terms of spatial frequency, color and luminance) required for target detection will be determined for input to target acquisition models. (Text Abridged)

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0008, ADVANCED RPV SYSTEMS SIMULATION
R.G. MILLS, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321230)

The objective is to apply computer simulation methodology to the analysis and design of Air Force RPV systems. Technology gaps have been identified that relate to the assessment of alternative RPV systems performance under (a) various sensor subsystems for reconnaissance and weapon delivery, (b) various techniques for processing imagery and reducing bandwidth, and (c) various general system conditions such as manned RPV mix technical scenarios, RPV guidance parameters, etc. Support documentation for these technological gaps is in development goals C-3-2, RI-4, RI-5, and MS-4, AMRL/ASD RPV SPO Memorandum of Agreement (24 Oct 75), Drone Near Real-Time Reconnaissance PMD (R- R5039(2), 30 Oct 75), Advanced RPV PMD (R-55011(2), 6 Jun 75), RPV Mission Control System PMD (R-R-5024(2), 5 Dec 75), Jam Resistant Imagery Transmission (Draft ADP, AFAL/AAD, Jun 75).

The approach is to develop a computer simulation of an RPV system that will serve as a test bed for obtaining system performance data. The computer simulation will employ teams of operators performing functions that they would normally perform in a real-world system in real-time. the computer simulation is to be as complete a representation of an rpv system as possible, thus necessitating the simulation of a large number of machine and environment elements (or subsystems) and their relationships over real-time. The simulation must also be flexible such that a variety of alternative RPV systems and sub- systems (e.g., sensors) can be tested. The products of this work are (a) general technical data relating to expected RPV system performance under testable conditions (e.g., performance under alternative mission scenarios, operating procedures, etc.), (b) expected RPV system performance data when alternative imagery processing techniques are employed in the system, and (c) expected system performance when alternative reconnaissance sensors are employed in the system. Products are in the form of technical reports and messages transmitting specific requested data or consultation information.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab HE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0009, CONFUSION SYSTEMS
R.D. ODONNELL, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321070)

To develop a fundamental data base on the mechanisms of visual sensation and perception capable of disrupting optical tracking and target identification. From the population of visual functions used in tracking and identification tasks, to isolate those which are capable of being distorted by some external manipulation. For these functions, to define the parameters within which such distortion might occur. The ultimate objective is to develop a systematized base of data from which the 'area of confusability' of any given visual function can be readily identified. This base will then permit objective definition of potential countermeasures in terms of a priori probability of success. Supports AFSC development goals S0-5, TC-5 and TC-8.

A committee of high-level national figures will be organized under a separate work unit to outline, in broad form, the visual functions most susceptible to disruption. This committee will similarly define risk/payoff matrices, and will identify additional requirements in the area of visual factors of optical countermeasures. These visual factors will then be studied in terms of the spatial, energy, spectral, and/or temporal parameters comprising them. Laboratory studies will be conducted to assess the impact on visual perceptual processes of manipulations of these parameters. An extensive literature search will be carried out to systematically identify work in which such parameters have previously been established. From these sources, definitive confusability matrices will be evolved. From a broader view, when enough information has been gathered to define these matrices, a describing function relating operator performance to broad ranges of sensory and cognitive perturbations will be developed.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab HE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0010, STUDY EXCESS SOUND ATTENUATION (ESA) AND DEVELOP ESA MODEL WITH RESPECT TO AIR-BASE/COMMUNITY NOISE

R.G. POWELL, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321410)

The noise produced on-base and in communities by Air Force airbase operations is a major environmental concern. The airstaff, MajComs, and airbases assess the impact of such noise by applying community noise predictive models (i.e., NOISEMAP) and noise data (i.e., USAF Bioenvironmental Noise Data Handbook, NOISEFILE) developed by AMD/AMRL under work units 72310418, 24, 25, 28, 31, and 33. The accuracy of these predictive models and data depend in large part on the accuracy of the alogrithms used to account for excess sound attenuation (ESA) caused by reflection/absorption of sound by the earth's surface/ground cover (e.g., sand, grass, crops), scattering caused by wind turbulence, obstacles (e.g., buildings, trees), and other factors. Although the ESA model presently used is the best available, it has significant uncertainties which cause corresponding uncertainties in the environmental noise assessments. The objective of this work unit is to develop better models for more accurately predicting ESA in forms suitable for practical implementation in NOISEMAP, the Handbook, and NOISEFILE.

AMRL will conduct airbase noise measurements over a 1-2 year period using 6-10 all-weather acoustic measuring stations. Data taken will define ESA over a range of 75 m to several kilometers from the source for all times of day/night, all seasons, various weather conditions, and for flat farm land and urban/suburban areas. Statistical analyses will provide the basis for new empirical ESA models which better define such attenuation for specific classes of conditions (e.g., day/night, rural/suburban, summer/winter).

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0011, IMPLEMENTATION OF ANSI SPECIFICATION S3.19-1974, PERSONAL HEARING PROTECTIVE DEVICES FOR USE IN NOISE ENVIRONMENTS

M.R. STEPHENSON, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321310)

AMRL/BBA is responsible for evaluating personal hearing protectors for use in AF hazardous noise environments. Military specification MIL- P-38268a specifies the procedures employed to evaluate hearing protectors, and requires the use of the ANSI real ear attenuation at threshold (REAT) method for the evaluations. The American National Standards Institute (ANSI) has recently revised the standard relevant to the REAT method. To maintain compliance with MIL-P-38268A, it is the objective of this work unit to procure and assemble the items necessary to implement the new measurement instrumentation and test methodology for use under 72310338.

Requirements necessary to implement the new standard will be identified, including specification of the instrumentation needed to generate the test signals and record the subjects' responses. A survey will be made of existing facilities to determine whether modifications of these facilities will be required, as well as to determine possible requirements to procure additional instrumentation. When the necessary equipment is available it will be assembled into an instrument console adjacent to the test room. Completion of this assembly will permit this laboratory to initiate hearing protector evaluations using the ANSI S3.19-1974 standard. Software will be developed to present the data in forms consistent with current methods and standards.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0012, EFFECTS OF HIGH-ACCELERATION INDUCED BRAIN BLOOD FLOW DISTRIBUTION ON HUMAN OPERATOR PERFORMANCE

J. YODER, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF322450)

To measure the effect of gz acceleration on cerebral blood flow rate and the impact of this stress-response interaction on human operator performance. To evaluate the relationships of cerebral blood flow values determined by radioactive microsphere distribution to cardiac output. To determine the efficacy of cerebral blood flow rate manipulation in terms of performance enhancement. This technology will define those physiological criteria which contribute to the optimization of human performance.

The effect of acceleration on intracerebral blood flow distribution will be determined by the injected radioactive microsphere technique. The rationale of indirect assessment of cerebral perfusion on the basis of cardiac output determination will be tested. Cerebral blood flow distribution as determined by radioactive microsphere dispersion will be ccorrelated with simultaneous dye dilution cardiac output determinations in animals. A broad spectrum of cardiac output values will be induced by provocative measures such as cardiac pacing, and acceleration. Modification of the behavioral effects of acceleration-associated cerebral blood flow rate by a variety of flow augmentation techniques will be delineated in instrumented, performance trained animals.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab EM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0013, NUCLEAR SURVIVABILITY OF AIRCREW - HIGH DOSE EXPOSURES

D.J. BARNES, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF321570)

The objectives of this project are to gain data to be used as relevant input parameters to models designed to predict the effects of irradiation upon human performance. Utilizing primates trained to perform tasks analogous to those accomplished by human operators of the B-1, radiation effects on performance can be determined and subsequently extrapolated to gain probabilities of mission success.

This work unit is the first phase of a two-part experimental procedure to examine 'worst case' and 'probable' environments expected to be encountered by aircrew personnel in the event of thermonuclear warfare. Six trained primates performing simultaneously on each of two tasks will be irradiated and pre-and post-irradiation performance measures taken. The decrement recorded in tracking, discrete avoidance, and reaction-time data will be utilized as input data to modeling efforts by USAFSAM and other DOD agencies.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine RA, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0014, OPERATIONAL GUIDELINES ON PLUS GZ-RELATED PATHOLOGY IN TACTICAL AIRCREW MEMBERS

K.K. GILLINGHAM, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322570)

To establish the probabilities of g-stress-induced damage to the heart and other organs of pilots flying high-performance fighter aircraft in simulated and actual aerial combat.

Before and at appropriate intervals after exposure of human volunteers to high levels of plus gz stress (more than 7.0 g) as part of ongoing centrifuge evaluations of g-protective hardware and personal equipment, noninvasive tests of subjects' cardiac function will be performed to determine whether any pathologic state or functional deficit has occurred in response to the g stress. ECGs, vectorcardiograms, echocardiograms, maximal stress treadmill tests, and serum enzymes and isoenzymes will be the cardiac tests of interest. In addition, vectorcardiographic and echocardiographic data collected previously on human subjects at and below 7.0 g will be analyzed for evidence of g-induced cardiac damage. Retrospective statistical studies on populations of F-15 and F-16 pilots will be carried out to determine whether repeated exposure to high levels of g stress in air combat training results in decreased heart function as measured by noninvasive cardiac testing. To the extent that pathological material can be recovered from deceased F-15 and F-16 pilots, an effort to identify g- stress induced lesions of the heart will be undertaken. Unfinished efforts begun under work unit 79300348 will be completed under this work unit.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0015, TRI-NATION EVALUATION OF AVAILABLE ALTITUDE PROTECTION TECHNOLOGY
T.R. MORGAN, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322630)

The advent of advanced concept fighter and multi-role combat aircraft has both broadened the spectrum of hazards to which aircrew are potentially exposed and led to a convergence of crew-protective philosophies among NATO allies. The US, Britain, and Canada, all share requirements to protect aircrew during high-altitude intercept, reconnaissance, or weapons delivery roles. However, only outdated, cumbersome and often dangerously compromising gear, using a variety of protective concepts and equipment combinations, is available for such needs. To assure the observance of critical minimum protective standards, working party 61 (of the Air Standardization Coordinating Committee) has ratified Air Std 61-011, a document which defines pressure-garment design and use criteria. To assure compliance with such guidance, together with developing a data base useful in updating/revising present recommendations, this effort will provide for continuing tri-nation cooperation in evaluation of available altitude protection technology. Previous work in this area has been documented under work unit 7164-11-01, the present work unit has been established by direction of HQ AMD to implement a new technology planning objective.

This organization has established appropriate liaison with the RAF Institute of Aviation Medicine (IAM) and Canada's Defense and Civil Institute of Environmental Medicine (DCIEM). Cooperative evaluation of selected in-service prototype garments will be conducted with test responsibilities divided among participants in a manner taking best advantage of the facilities/expertise available within each organization. Data obtained from tests of flying gear will be used to assess its compliance with existing guidance, determine suitability for use in specific flying roles and from a data base useful in future equipment design.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0016, COST ANALYSIS OF PILOT SELECTION
M.J. REE, U.S. Air Force, Human Resources Laboratory, *San Antonio, Texas* 78236 (DF233000)

Develop various configurations for pilot selection systems and assess the associated costs.

Various combinations of paper-and-pencil testing, psychomotor testing and simulator testing (GAT-1) will be specified. Life cycle cost estimates, research and development, acquisition, operation and support, will be developed. The results of this cost analysis will be applied to a second phase of research consisting of a cost-effectiveness study for pilot screening devices. Milestones: identify cost elements for the selection systems 10 Sep 76 to 1 Oct 76, estimate costs for each selection system 2 Oct 76 to 30 Nov 76, prepare analysis report 1 Dec 76 to 31 Jan 77.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory PES, Lackland AFB, Texas 78236

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0017, CREW SYSTEMS REQUIREMENTS FOR RIVET JOINT MISSION-CREWS
W.F. STORM, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322200)

The objective of this work unit is to provide test and evaluation of the rivet joint modernized system on equipment/console design, crew accommodations (galley, latrine), and environmental conditions of the aircraft.

Using questionnaires and critical incident surveys, the suitability of equipment location for use and repair will be determined, configurations which are injurious to crewmembers during stable and/or unstable flight will be identified, and comfort/fatigue factors such as temperature, noise, and vibration will be evaluated. This effort was previously documented under 7930-09-11.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0018, ENHANCEMENT OF AIRCREW PERFORMANCE BY OPTICAL EQUIPMENT
T.J. TREDICI, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF321970)

Optical devices have the potential to enhance flight crew performance and/or facilitate in-flight procedures. In order to insure that AF aircrews are provided with optical aids which can optimize their performance, development and testing of visual devices will be on a continuous basis.

The USAFSAM will respond to operational problems identified from the field for development assistance and/or in planned research efforts where a long-standing need may exist. Filter enhancement for target detection, multifocals designed specifically for cockpit use, and new spectacle frame developments in new plastic materials will be studied. Efforts under this work unit were previously documented as work unit 7755-09-03.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0019, ADVANCED INSTRUCTOR OPERATOR STATION DISPLAY EVALUATION TECHNIQUES
W. LEE, Boeing Company, *Seattle, Washington* 98108 (DF228130; F33615-77-C-0017)

Develop techniques for scientifically measuring and quantifying display effectiveness as it relates to the performance monitoring task of an instructor pilot during aircraft simulator operation. Recent and current AF specifications require or permit the use of CRT displays for providing performance relevant information to the instructor pilot. When a CRT is used, there are a great number of ways by which flight and performance data may be illustrated. Justification for choosing or developing one method over another is seldom if ever provided in terms of hard data due to the virtual non-existence of such data. This work will develop techniques for providing this data.

The contractor will review instructor pilot duties at the IOS and devise tasks which are sensitive to display techniques and formatting. Contractor will also devise measures to be applied to this task which can be used to quantify the effectiveness of various alternate displays used in conjunction with this task.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory ASM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, MULTIVARIABLE PROBLEMS OF STATISTICS AND INFORMATION THEORY
J.N. SRIVASTAVA, Colorado State University, School of Natural Sciences, *Fort Collins, Colorado* 80521 (DF046270; AF-AFOSR-3127-77)

AF function - command, control and communication - information retrieval systems - improve the methods of data collection and analysis. Deficiency - good and efficient statistical methods still need to be developed for collecting and analyzing data related to the different factors influencing the function of command, control and communication systems, hierarchical information retrieval schemes - pattern recognition and optimal design theory. Objective - develop good basic results to help improve coding methods, information retrieval systems, reduce costs and save time in the collection of large amounts of data without any damage to the statistical quality of the data being collected, improve the methods of clustering and pattern recognition. How work contributes - improve the methods used in investigations using experimental units that are scarce or costly, improve the efficiency of coding schemes, help model the construction of

hierarchical information retrieval schemes, improve the existing results in clustering used, for example, in pattern recognition.

Research will be conducted in several areas which can help the researchers from the beginning to the final stage of their experiments. The main problem areas to be studied are: (1) Finding upper bounds for the efficiency of codes, which help in finding optimum codes. Further work will be done on the properties and decoding of Srivastava codes, on codes designed for communication over a band-limited channel perturbed by white Gaussian noise and satisfying an equal power input constraint. (2) Do further work on the construction of hierarchical information retrieval schemes. (3) Further work on the theory of optimal designs. (4) Hierarchical clustering. (5) Multivariate analysis and multiresponse designs, particularly on problems with missing data. (6) Choice of variables in regression analysis. (7) Search linear models, particularly the inference aspect of such models.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

7.0002, SPECIAL FUNCTIONS CELESTIAL MECHANICS

G. GASPER, Northwestern University, School of Arts & Sciences, *Evanston, Illinois* 60201 (MCS76-06635)

George Gasper will continue his work on the development of methods for proving the positivity of a variety of kernels involving sums and integrals of special functions and will also work on the derivation of new multiplier criteria of Marcinkiewicz type for Jacobi series.

Donald G. Saari will continue his work on the n-body problem of celestial mechanics emphasizing the asymptotic properties of all solutions and the structure of initial conditions leading to these behaviors. In addition, he will initiate some projects in mathematical economics, emphasizing problems of (pareto) optimal solutions, and in mathematical psychology emphasizing adaptation and adjustment mechanisms in cognitive development.

SUPPORTED BY U.S. Natl. Science Foundation

7.0003, AN ANALYSIS OF THE LOGAIR DISTRIBUTION SYSTEM USING OPTIMIZATION PRINCIPLES

J.L. KENNINGTON, Southern Methodist University, Graduate School, *Dallas, Texas* 75222 (DF046150; AF-AFOSR-3151-77)

AF function - LOGAIR is an air freight network used by USAF to support its major installations. Deficiency - the two civilian carriers make no routing or scheduling determinations. This is done by personnel at AFLC, using methods based on experience and certain estimations. The result is an arrangement that is almost surely far from best. Objective - to bring some mathematical theory of scheduling and integer programming to bear on the problem to increase the amount of freight transported or to decrease the cost of the transportation operation. How work contributes - the work would be the only theoretical effort that addresses this particular problem. Any improvement, even is not the optimum solution, would result in cost savings of millions of dollars to the Air Force.

A combination of improved interfacing among routes, better scheduling, and alternative aircraft assignments matched to flow requirements would significantly alleviate the present deficiencies in costly abnormally long 'pipeline' times. The methods to be used are part of the science of mathematical programming.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM, Bldg 410, Bolling AFB, Washington, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, PIXE ANALYSIS FOR ENVIRONMENTAL AND BIOLOGICAL SAMPLES

G.B. BAPTISTA, Pontifical Catholic University, *Rio De Janeiro, Brazil* (1927/RB)

A program of elemental analysis by proton-induced X-ray emission (PIXE) is being implemented with the 4.0 MeV Van de Graaff accelerator of PUC/RJ. Absolute calibrations and intercomparison studies will check the reliability of measurements. Analyses will be made of air particle samples collected with Nucleopore filters in a cascade impactor. Variations in elemental concentrations in local air particulates will be observed and attempts will be made to correlate these fluctuations with seasonal variations, rain levels, and other atmospheric conditions. Possible correlations with suspected sources of pollution will also be investigated. Background levels from unexposed filters are currently being measured. Calibration samples with known quantities of various elements of interest deposited of filters are being tested for possible systematic variations.

ADDENDA: Performing organization: Pontificia Universidade Catolica do Rio De Janeiro, Departamento de Fisica.

SUPPORTED BY Internat. Atomic Energy Agency - Austria

8.0002, HIGH-ENERGY PARTICLE PHYSICS

W.B. FRETTER, Univ. of California, Graduate School, *Berkeley, California* 94720 (PHY77-02487)

The Fretter-Bingham group is involved in several experiments with bubble chambers at Fermilab and the Stanford Linear Accelerator Center (SLAC). 1. Anti-neutrino interactions in the Fermilab 15-foot bubble chamber filled with a heavy mixture of neon and hydrogen E-172. 2. Negative pions at 205 GeV/c incident upon the 30-inch hydrogen chamber at Fermilab E-137. 3. A pi-d experiment at 15 GeV/c performed at SLAC in the 82-inch bubble chamber BC-43. 4. An exposure of the Fermilab 15- foot chamber filled with light neon-hydrogen mixture in a beam of high energy negative pions E-389.

This work represents a continuation of that currently supported by Foundation grant PHY71-02866 AO4.

SUPPORTED BY U.S. Natl. Science Foundation

8.0003, LOCALIZED MOMENTS AS SPIN LABELS IN SOLIDS

R.L. ORBACH, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (DMR76-82347)

This research will be a continuation and extension of work begun under NSF Grant No. DMR72-02935. Magnetism and superconductivity will be studied in metallic thin films utilizing magnetic resonance, critical field measurements and conductivity measurements. The geometry of the samples will include both superconductor-normal composites (proximity effect sandwiches) and granular superconductors. The principal focus of the experiments will be on spin scattering rates in superconductors, the spatial dependence of the superconducting order parameter in proximity effect sandwiches, and the fluctuation properties of granular superconductors which exhibit both zero and two-dimensional behavior. Two other areas of research also will be undertaken. Orbit-lattice interactions in thin films will be studied by electron spin resonance and susceptibility measurements and mixed valency will be studied for Eu ions in a LaRh2 matrix.

SUPPORTED BY U.S. Natl. Science Foundation

8.0004, TEMPERATURE DEPENDENCE OF THE STRUCTURE OF LIQUID METALS

C.N. WAGNER, Univ. of California, School of Engin. & Appl. Sci., *Los Angeles, California* 90024 (DMR74-08532 A01)

The scattering of x-rays from liquid metals will be measured as a function of temperature. The transmission technique will provide accurate data particularly at small scattering angles, and the reflection technique will be used to complement the data at larger scattering angles. These data are needed to evaluate the interference function I(K), the atomic distribution function g(r) which is the Fourier transform of I(k), and the direct correlation function c(r) which is the Fourier transform of C(K) equals 1 - 1/I(K). Values of the interatomic distances and the coordination numbers

will be determined from g(r) and 4 pi r2 pog(r), respectively, in the liquid of atomic density po. The pair potential phi(r) will be deduced from g(r) and c(r). The interference function I(k) can be directly correlated with the electronic transport properties of liquid metals. Using known pseudopotential form factors U(K), the temperature coefficients of resistivity will be determined from the experimental I(K) between K equals zero and twice the Fermi momentum kF. After completion of the investigation of the temperature dependence of the structures of liquid Ga and Sn, existing data on liquid In, Cd, Zn, Al, Mg, Na, K and Cs will be extended to higher temperatures. This is a renewal of NSF Grant DMR74-08532.

SUPPORTED BY U.S. Natl. Science Foundation

8.0005, 5TH INTERNATIONAL CONFERENCE ON ATOMIC PHYSICS
R. MARRUS, U.S. Energy Res. & Dev. Admin., *Oakland, California* 94612 (DN675062; NAONR-1-76)

This grant furnishes partial support for the 5th international conference on atomic physics. The objective is to review current work on such topics as cross-sections and oscillator strengths of interest to the Navy as input to codes to estimate radio-communications, atomic weapons effects, and ballistic missile detection, as well as in the design of laser systems.

Scientists of international repute will analyze, review, and advance current methods in experimental and theoretical physics as applied to electron, atomic and molecular gaseous phenomena. applications of results to technological areas will be considered. Among the topics to be discussed are: electron-atom, electron-molecule differential inelastic scattering cross-sections as input to atmospheric transport codes; oscillator strengths of diatomic and triatomic molecules for infrared signature determination; and quantum mechanics and semi-classical theory applied to ion-atom collision phenomena.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0006, NUCLEAR STRUCTURE INVESTIGATIONS WITH A 15-MEV TANDEM VAN DE GRAAFF ACCELERATOR
S.S. HANNA, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (PHY73-08491 A05)

This work will include the study of giant resonances using the method of radiative capture. Polarized proton beams from the FN tandem accelerator are used extensively in these studies. Work will also continue on interactions of nuclei with the hyperfine fields of atoms in solids, which allows, for example, the accurate measurement of nuclear moments.

This work is a continuation of that currently supported by PHY73-08491-A04.

SUPPORTED BY U.S. Natl. Science Foundation

8.0007, MAGNETIC BUBBLE DOMAIN DYNAMICS USING HIGH-SPEED PHOTOGRAPHY
F.B. HUMPHREY, Calif. Inst. of Technology, School of Engineering, *Pasadena, California* 91109 (DMR75-00420 A02)

The dynamics of magnetic bubble domains and domain walls will be investigated using a fast optical sampling microscope. With this microscope and sampling system, a single 10 nsec exposure photograph of the transient bubble or stripe domain configuration is taken and time- sequenced sampled during a single reversal. The investigation will concentrate on single crystal materials of mixed rare earth garnets of the type useful for bubble devices. These samples are made by liquid phase epitaxial growth on a Gd3Ga5O12 substrate. Stripe domains will be investigated with an emphasis on wall structure. Both hard and soft walls will be investigated as well as the nature of the vertical Bloch line during wall displacement. A search for the wide diffuse boundary will be made in stripes. For bubble domains, the emphasis will be on dynamic characteristics important to devices. Domain translation and ballistic overshoot will be investigated as well as other dynamic characteristics of bubbles with few vertical Bloch lines. Radial velocity will be investigated to relate the maturation velocity to capping layers and inplane fields. The dynamics of bubble collapse will be investigated as well as the wide diffuse wall in bubbles. Bubble physics in field access devices will be studied as well as in simplified propagating structures with the aim of bridging the gap between investigations of free bubble and bubbles in operating devices. Bubble- bubble interactions of the kind of interest for logic devices will be included.

This is a renewal of NSP Grant DMR 75-00420.

SUPPORTED BY U.S. Natl. Science Foundation

8.0008, HIGH-ENERGY PHYSICS
G.E. MASEK, Univ. of California, Graduate School, *San Diego, California* 92037 (PHY76-83355)

This group is continuing its studies of electron-positron annihilation at the Stanford Linear Accelerator Center colliding beam facility, SPEAR. 1. Analysis of decays of psis psi prime and 4.2 GeV states via gamma ray emission. 2. Analysis of data taken to study two photon and other processes among the reactions: positron plus electron yields positron plus electron plus X.

Little is known about this reaction. The experiment in progress will explore the nature of these events and search for the production of states with even charge conjugation.

This work is a continuation of that currently supported by Foundation grant PHY72-04426 A08.

SUPPORTED BY U.S. Natl. Science Foundation

8.0009, ENERGY TRANSFER AND OPTICAL SPECTROSCOPY OF DIATOMIC MOLECULES IN CHEMICALLY REACTING SYSTEMS
H.P. BROIDA, Univ. of California, School of Letters & Science, *Santa Barbara, California* 93106 (DF046710; AF-AFOSR-3138-77)

AF function - detection, communication, weaponry. Deficiency - a lack of a chemically pumped, electronic transition laser operating efficiently in the near IR or visible region of the spectrum. Objective - perform detailed studies on the kinetics of room temperature reactions of copper atoms with fluorine compounds and careful measurements of absolute photon yields into specific electronic and vibrational states of CuF. How work contributes - the bright chemiluminescence from the reaction of Cu vapor with F2 or NF3 makes CuF attractive for a visible chemical laser. The research will be carried out as a prototype study which can be applied to the evaluation and development of future metal- oxidant reactions which show promise in chemical laser applications.

A detailed knowledge of the molecular structure of CuF including molecular constants, transition probabilities and radiative lifetimes will be acquired by high-resolution conventional and laser spectroscopy. Detailed mechanisms on the formation and loss of electronically excited diatomics and for vibrational relaxation will be developed. Additionally, optically pumped metal dimers, as attractive systems for visible, tunable gas lasers, will be studied by applying knowledge of the electronic states of Rb2, Cu2 and Bi2 to determine the efficiency and tunability of these lasing media. Laser photoluminescence and high resolution spectroscopy will be used to investigate other small molecules which are of atmospheric, combustion, and chemical laser interest.

ADDENDA: Supporting agency address is: AF Office of Scientific Research, NC Bldg 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0010, PARAELECTRIC STUDIES IN INSULATORS
F.G. BRIDGES, Univ. of California, Graduate School, *Santa Cruz, California* 95060 (DMR76-21342)

The study of paraelectric systems using resonance spectroscopic techniques previously supported by NSF grant DMR71-01818 will be continued. The paraelectric resonance (PER) studies of KBr crystals doped with 6Li and 7Li will be continued. These systems are unusual in that they have very large zero field splittings and very large isotope shifts which have not yet been observed in other experiments. The nature of this center and the parameters which describe it will be determined. Further measurements will be taken on the related NaCl:Li system. Broad-

band PER spectroscopy (12-50GHz) will be used to investigate other paraelectric centers with large zero field shifts. A set of experiments using phonon spectroscopy at high frequencies (to 500GHz) will be done to complement previous studies and provide a direct measurement of stress coupling for several systems. Experiments will be initiated using double resonance techniques on paraelectric systems.

SUPPORTED BY U.S. Natl. Science Foundation

8.0011, ELEMENTARY PARTICLES AND HIGH-ENERGY PHENOMENA

U. NAUENBERG, Univ. of Colorado, School of Arts & Sciences, *Boulder, Colorado* 80302 (FY-76-C-02-2114.000)

For the next year our goals are the following: 1) To complete the measurement of neutral particle fluxes in a pion-produced Ko beam and use the results for a proposed neutronless Ko beam at Fermilab. 2) To complete the analysis of dimuon events produced in the iron ball experiment at SPEAR. 3) To accumulate data in an exposure of Lexan detectors to magnetic monopoles above Fermilab's fifteen-foot bubble chamber. 4) To build large Cherenkov counters and proportional chambers for the tagged photon facility at Fermilab. Our theoretical investigations will support these activities. In addition, we will study the behavior of renormalization constants for bound states.

RESULTS: In the decay of the neutral kaon we have found: 1) that the CP-violating parameter, eta, is about 10 percent higher than previously determined; 2) that CPT is conserved to within 2 percent; 3) that a quadratic term is needed in the matrix element for KL (pi 3) decay; 4) that the delta I equals 1/2 rule is violated in this decay. We have also found no evidence for the production of tachyon monopoles near a nuclear source or in cosmic rays. We have shown that scaling can be used to predict particle production distributions of higher energies.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0012, TOPICS IN THEORETICAL PLASMA PHYSICS

I.B. BERNSTEIN, Yale University, School of Engineering, *New Haven, Connecticut* 06520 (PHY76-06191 A01)

Energy-related research initiated under NSF grant PHY74-11535 AO1 will continue. Topics in theoretical plasma physics to be investigated include: 1) Fluctuations and Diffusion in Velocity Space: An inhomogeneous wave kinetic equation for fluctuating plasmas will be developed and adapted to the determination of velocity space diffusion coefficients. 2) Theory of a Plasma Diode: Improved theoretical models of the plasma diode of Hirshfield et al. will be developed. 3) Geometric Versus Wave Optics: The regimes of validity of wave and geometric optics in laser-produced plasmas will be quantitatively determined. Research will establish how solutions can be asymptotically joined. 4) Boundary Layer Phenomena: Work will concentrate on solving the reduced kinetic equation for the particle distribution function near an absorbing wall or diverter so as to obtain an improved knowledge of the boundary layer. 5) Theory of Laser-Produced Plasma: Studies will develop an improved hydrodynamic and/or quasi-kinetic model to provide a better global description of the space-time history of a laser-produced plasma. 6) Transport in Magnetically Confined Systems: Work on transport will be extended to moderately non-axisymmetric systems.

SUPPORTED BY U.S. Natl. Science Foundation

8.0013, BASIC PLASMA PHYSICS

J.L. HIRSHFIELD, Yale University, School of Engineering, *New Haven, Connecticut* 06520 (PHY76-00662 A01)

Studies will continue of the plasma formed in laser-initiated vacuum arc. In particular, some aspects studied will be: a novel method of ion confinement; fundamental properties of plasma in a new range of density, temperature, volume, and lifetime; the formation of high-Z plasmas and their use in ion sources and isotope separation.

SUPPORTED BY U.S. Natl. Science Foundation

8.0014, COLOR CENTERS, ION PENETRATION, AND CHANNELING IN INSULATING CRYSTALS

R.B. MURRAY, Univ. of Delaware, School of Arts & Sciences, *Newark, Delaware* 19711 (DMR76-08550)

Research previously supported by NSF grant DMR72-03154 will be continued. This is an experimental research program dealing with the interaction of energetic charged particles with insulating crystals, especially effects associated with channeling, ion penetration and radiation damage, and scintillation phenomena. Specifically, the program will involve experiments on the following: Recombination of point defects in KC at low temperatures; channeling effects in alkali iodide scintillators; positive-ion damage and defect recombination in MgO; microdosimetry in F center formation by positive ions in KC; stopping power for protons in KC by Rutherford backscattering experiments; and, radiation damage recovery in alkali halides.

SUPPORTED BY U.S. Natl. Science Foundation

8.0015, LOW- AND MEDIUM-ENERGY NUCLEAR PHYSICS RESEARCH

M.B. GREENFIELD, State University of Fla. Sys., School of Science & Technology, *Tallahassee, Florida* 32307 (PHY77-03313)

Florida A & M University will participate in low- and medium-energy nuclear physics research at the following institutions: The Los Alamos Meson Physics Facility (LAMPF); the Indiana University Cyclotron Facility (IUCF); and the Florida State University Super FN Tandem Accelerator, Tallahassee, Florida (FSU). The following projects will be continued or initiated: (1) Mechanisms of (pi , pi N) Reactions on Complex Targets LAMPF); (2) A Survey of Quasi-Elastic Pion Scattering (LAMPF); (3) Comparison of the Quasi-Elastic Ratio sigma(pi-,pi- n)/sigma(pi ,pi n) to the Ratio sigma(pi , pi p)/sigma(pi-,pi-p) in a Coincidence Experiment (LAMPF); (4) Studies of Gamma Ray Correlations in Scattering of Pions (LAMPF); (5) Set-Up of Beam Rotating System for Time-of-Flight Experiments (IUCF); (6) A Study of the Isospin Makeup of Giant Resonances (IUCF); (7) A Study of 8 Be Producing Reactions (FSU).

This work will be performed in collaboration with user groups from a number of other institutions, including Florida State University, Oregon State University, University of Oregon, Virginia Polytechnic Institute, University of Texas, Oak Ridge National Laboratory and Kent State University.

This work is a continuation of that performed under Foundation grant SER74-12883 A01.

SUPPORTED BY U.S. Natl. Science Foundation

8.0016, NUCLEAR SPECTROSCOPY WITH RADIOACTIVE SOURCES

R.W. FINK, Georgia Inst. of Technology, School of Chemistry, *Atlanta, Georgia* 30332 (EY-76-S-0503346)

Low-energy nuclear structure studies with radioactive sources is the central effort of this research. The experimental measurements are carried out largely with UNISOR facilities (University Isotope Separator at Oak Ridge) and heavy ion beams from the Oak Ridge Isochronous Cyclotron. Nuclides far from stability are studied on- and off-line in the mass regions 185-201, with extensions planned in the A equals 125 and rare earth regions. State-of-the-art measurements of lifetimes of nuclear levels are being performed by delayed coincidence (0.1-800 nanosec) and by a new computer-based technique of multiple time analysis (10 microsec-1 sec). The experiments provide tests of particle-core coupling and the concept of an effective core, the triaxial rotor model, the shell model and intruder states, and a residual quadrupole pairing force. The UNISOR data tapes are processed and analyzed either at Oak Ridge (SEL computers) or on the Georgia Tech CDC-Cyber-70 computer. Nuclear spectroscopy studies on certain radioactive (n,n'), (n,p), (n,gamma), and (n,2n) reaction products produced by 14-15 MeV neutrons in an enriched Li6D capsule placed in the Georgia Tech Reactor will be carried out, following final fabrication of the capsule with a zircalloy-2 outer container and measurement of the 14-15 MeV neutron flux produced.

RESULTS: Results are summarized in the current annual report, ORO- 3346-196, and include 29 publications and abstracts,

1 Ph.D thesis, 1 M.S. thesis completed, and several papers at international conferences, and invited seminars, colloquia, and talks in other institutions in USA and in Europe.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0017, LIGHT SCATTERING STUDIES IN SEMICONDUCTORS AND DISORDERED SOLIDS
M.V. KLEIN, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (DMR77-04382)

Research studies of electronic Raman scattering by electrons in semiconductor and disordered solids previously supported by NSF grant DMR-7307564 will be continued. A sum-rule for valley-orbit Raman scattering which can provide information about electron delocalization near the metal-insulator (M-I) transition in n-type silicon will be applied to an analysis of experimental data for phosphorus-doped silicon using a more sensitive detector. The valley-orbit donor Raman line will be studied under uniaxial stress as a function of concentration near the M-I transition, and the sum-rule will be generalized to cover stresses. The technique of resonant surface Raman scattering using visible lasers will be applied to electronic Raman scattering in semiconductors. Light scattering also will be used to study relaxation processes in solids including those processes that produce a dynamic central peak and couple to acoustical phonons. Examples include relaxation processes in glass, individual ionic hopping processes in fast ion conductors, and soft modes in ferroelectric crystals.

SUPPORTED BY U.S. Natl. Science Foundation

8.0018, NUCLEAR STRUCTURE AND NUCLEAR PROCESSES AT INTERMEDIATE ENERGIES
R.D. BENT, Indiana University, School of Arts & Sciences, *Bloomington, Indiana* 47401 (PHY76-84033)

The Indiana University Cyclotron Facility provides beams of protons, deuterons, helium ions and lithium ions at energies up to 160 million volts for nuclear structure research. Other beams are being developed. The research is performed by a large community of users from outside the University as well as by a large Indiana University group. Many of the experiments are performed as collaborations between Indiana University scientists and scientists from other institutions.

The research performed is in the area of studies of the properties of nuclear ground states and excited states by means of a wide variety of techniques, using the precisely defined particle beams from the cyclotron and detection devices such as a magnetic spectrometer and solid state detectors. An active program of studies of pion production near threshold is in progress.

This work is a continuation of that conducted under Foundation grant PHY75-00289AO3.

SUPPORTED BY U.S. Natl. Science Foundation

8.0019, INVESTIGATIONS IN THE THEORY AND INTERPRETATION OF PARTICLE COLLISIONS
R.G. NEWTON, Indiana University, School of Arts & Sciences, *Bloomington, Indiana* 47401 (PHY75-18942 A01)

Theoretical research in general quantum scattering theory will continue. Topics will include work on the 3- and n- body problems, the determinantal method, specific three-nucleon calculations, and the inverse scattering problem for three-dimensional potentials that are not spherically symmetric.

This work is a continuation of that currently supported by Foundation grant GMPS71-03310 AO2.

SUPPORTED BY U.S. Natl. Science Foundation

8.0020, ELECTRONIC AND VIBRATIONAL SPECTRA OF SOLIDS
A.K. RAMDAS, Purdue University, School of Science, *Lafayette, Indiana* 47907 (DMR76-04775 A01)

Research carried out under NSF Grant DMR-7101774 on the electronic and vibrational spectra of solids will be continued. A series of experimental and theoretical investigations in Raman, Brillouin, and infrared spectroscopy of crystals will be undertaken. The effects of uniaxial and hydrostatic stress and of an electric field on the Raman spectra of a number of crystals will be examined with a view to determine (1) deformation potential constants and symmetries of phonons, (2) soft modes which underly phase transitions, and (3) kinetics of defect reorientation revealed through their local modes. Brillouin scattering studies will be made in pure, highly doped, many-valley semiconductors and in the polytypes of silicon carbide. A number of optical investigations at ultra-high pressures will be initiated, including Raman scattering and visible/infrared reflection and absorption experiments. In these measurements the emphasis will be on understanding the mechanisms of phase transitions by studying the pressure-induced changes in electron and photon properties. Additionally, the luminiscence of ruby at very high pressures will be studied. Research on impurity states in semiconductors including investigations of lithium and lithium oxygen complexes in silicon and germanium, effects of electron irradiation on impurity spectra, interstitial donors, and 'two-particle' excitation will be carried out. Piezospectroscopy will be employed in these studies. Photoconductivity and photothermal ionization spectra will be studied as a part of the program.

SUPPORTED BY U.S. Natl. Science Foundation

8.0021, BAND THEORY OF FERROMAGNETIC METALS
J. CALLAWAY, Louisiana State Univ. Systems, School of Chemistry & Physics, *Baton Rouge, Louisiana* 70803 (DMR76-19850)

This research will continue investigations in theoretical solid-state physics concerning the band theory of ferromagnetic metals. The projects to be undertaken include improved calculations of band structures, and use of the resulting energy levels and wave functions to study optical, electronic, and magnetic properties of iron and nickel.

Reference: DMR73-02572 A01.

SUPPORTED BY U.S. Natl. Science Foundation

8.0022, INVESTIGATION OF NUCLEAR STRUCTURE BY MEANS OF INELASTIC ELECTRON SCATTERING
P.D. ZIMMERMAN, Louisiana State Univ. Systems, School of Chemistry & Physics, *Baton Rouge, Louisiana* 70803 (PHY76-82879)

Measurements will be made of quasi-elastic scattering of electrons from carbon-12 as a function of energy transfer and momentum transfer. Data will be taken at small momentum transfers using the William E. Bates linear accelerator at M.I.T., while data at large momentum transfers will be obtained in separately funded experiments using the accelerator at Saclay, France. The results of these experiments are expected to give information on the validity of fundamental sum rules for nuclear transitions.

Elastic and inelastic scattering of electrons from chlorine-35 and chlorine-37 will be studied at M.I.T. in collaboration with a group from Catholic University. These experiments are expected to give information on nuclear transition matrix-elements of special interest in connection with experiments attempting to observe solar neutrinos.

This work is a continuation of that performed under Foundation grant PHY76-00995 A01.

SUPPORTED BY U.S. Natl. Science Foundation

8.0023, MICROBUBBLE STATES IN LIQUID HELIUM IN THE PRESENCE OF ULTRASONIC CAVITATION AS PROBED BY THE INJECTION OF EXCESS ELECTRONS
C.W. SMITH, Univ. of Maine, School of Arts & Sciences, *Orono, Maine* 04473 (DF045790; AF-AFOSR-3113-76)

AF function - this proposed research primarily falls in the 5.3 research objectives which deal with electrical power for manned and unmanned aircraft, satellites and space stations. Research is required in the generation of usable electric power from non-nuclear energy sources, distribution and conditioning of the power and the attendant material requirements. The superconducting generators and pulsed superconductive energy storage systems have the requirement that the temperature of the systems be below the critical temperature. Thus one needs to understand the heat transport and other physical properties of liquid helium.

Deficiency - as an example of the reason one needs more efficient ways of keeping the systems cool, over 90 percent of the weight of a superconductive energy storage system results from the cryogenic coolant and its storage container. Objective - the objectives of this proposal are to study the nucleation, growth, stability and decay of microbubbles in liquid helium. One can significantly change (below and above the lambda point) certain thermodynamic properties as thermal conductivity, viscosity, etc. which can be probed by the microbubbles. Also understanding the nucleation and stabilization of bubbles fields has implications in the storage and handling of cryogenic liquids as well as ordinary liquids near their boiling point. Another objective is to study the dynamics of microbubbles in a sound field. Contribution - this research is a part of a comprehensive program in superfluids and superconductors.

The approach in this proposal is to study the injection of excess electrons into liquid helium by examining energy shifts and photo current shape changes of the photo response curve with temperature, ultrasonic amplitude and ultrasonic frequency. The studio will include mobility measurements as a function of temperature and ultrasound parameters. Sound on and off experiments will be used to initiate studies of the dynamics of bubble formation and decay. These studies will lead to further experiments involving cavitation and acoustic spectra. The proposed study encompasses both basic and applied aspects of processes in liquids involving charge transport, bubble nucleation, stability and decay, electron bubble formation and interaction with sound and cavitation. (Text Abridged)

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0024, NONLINEAR MECHANICS OF UNSTABLE PLASMAS

H. LASHINSKY, Univ. of Maryland, Inst. For Fluid Dyn. & Math., *College Park, Maryland* 20742 (DF045870; AF-AFOSR-3129-76)

AF function - aerospace vehicles. Deficiency - knowledge of plasma resistivity pertaining to arc-heated plasma wind tunnels is largely based on overall current and voltage measurements which cannot provide spatial resolution, the use of trial functions to describe the temperature dependence of the conductivity, also the physical theory of conductivity available is only valid for a range of plasma parameters such that the number of particles within a Debye sphere is large compared to 100, whereas the experimental conditions are such that this number is from 10 to 100. This poor state-of-the-art hampers rationally based design improvements of arc plasma gas heating devices. Objective - to evaluate the feasibility of using a newly developed technique for measuring plasma electrical conductivity in plasma wind tunnels and plasma arcs, to investigate a newly discovered plasma transparency effect that could have applications to communication with vehicles otherwise in the plasma blackout situation. How work contributes - accurate measurements of gas electrical conductivity as a function of density, temperature and magnetic field intensity will furnish a foundation for more satisfactory theories of these phenomena relevant to the actual parameter ranges of interest in plasma arcs and wind tunnels.

Q-machine plasmas of controlled temperature, density, magnetic field intensity and turbulence level will be probed to obtain conductivity both parallel and perpendicular to the field direction. A newly discovered transparency effect that is possibly capable of providing a communication window through dense reentry shock layer plasmas will also be investigated.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA, Bldg. 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0025, STATISTICAL MECHANICS OF MATERIALS NEAR PHASE TRANSITIONS

H.E. STANLEY, Boston University, Graduate School, *Boston, Massachusetts* 02215 (DMR76-82481)

Research supported under NSF DMR72-03046 will be continued. Specifically, work on quasi-two-dimensional materials, materials displaying higher order critical points and materials that order to helicoidal structures will be expanded upon.

SUPPORTED BY U.S. Natl. Science Foundation

8.0026, THEORETICAL STUDIES OF HIGHLY IONIZED SPECIES

A. DALGARNO, Harvard University, Harvard College Observatory, *Cambridge, Massachusetts* 02138 (EY-76-S-02-2887)

A relativistic generalization of the random phase approximation has been developed that permits the non-perturbative incorporation of relativistic effects and extends the theory to allowed and forbidden transitions of all multipolarities. Calculations for E1(21,3P1-1So), M1(23S1-11So) and M2(23P2-11So) transitions in the helium isoelectronic sequence for Z up to 100 have been carried out, as well as transitions between excited states for all n equals 2 levels. The method has also been applied to the beryllium isoelectronic sequence.

Model potential methods have been used to calculate M2 transitions from the 3P2 metastable levels of lighter members of the beryllium and magnesium-like ions.

Also studied are: resonating states in the lithium isoelectronic sequence, two-photon processes in sodium, and radiative charge transfers of C plus 2, C plus 3 and N plus 3 to D.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0027, PRESSURE DEPENDENCE OF THE OPTICAL PROPERTIES OF COVALENT SOLIDS

M. KASTNER, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (DMR76-11972)

The foundation of the chemical bond description of solids rests on an identification of a spectroscopically determined energy with the average chemical bond energy. This identification appears to work well for materials with an average valence of four; however, for materials with an average valence less than four, it has been shown that local field corrections alter this relationship. In order to extend the usefulness of the chemical bond approach to these solids, the problem of local fields is investigated by measuring the pressure dependence of the optical properties. A highly sensitive reflectometer has been built and measurements performed on amorphous and crystalline selenium. The results give strong evidence that selenium has highly localized valence charge. Measurements of other materials (crystalline and amorphous arsenic sesquiselenide (As2Se3), arsenic sesquisulfide (As2S3) and arsenic) with intermediate-to-small chemical valence is underway. In addition, the pressure dependence of the reflectivity of Si will be measured. This measurement should provide a test of whether one can distinguish local field effects from density-dependent polarizability. The temperature dependence of the reflectivity of the materials previously mentioned also will be measured. In this way the effect of electron-phonon interactions on the local field corrections can be investigated.

SUPPORTED BY U.S. Natl. Science Foundation

8.0028, ABSOLUTE NEUTRON CROSS SECTION MEASUREMENTS

G.F. KNOLL, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (EY-76-S-02-2025)

We plan to continue the application of a variety of photoneutron sources to the measurement of absolute fast neutron cross sections. Primary emphasis will remain with the measurement of fission cross sections, and we plan to extend our current efforts on 235U and 239Pu to include measurements on 233U and 237Np. We also plan to carry out (n, alpha) and (n, gamma) cross section measurements on nuclides of primary interest as standards.

RESULTS: Cross section value have been obtained for 235Pu at four photoneutron energies. Integral values have also been obtained using 252Cf fission neutrons. A determination of nu-bar for 252Cf has also been obtained.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0029, MILLIMETER MICROWAVE SPECTROSCOPY OF HIGH-PURITY METALS

G.L. DUNIFER, Wayne State University, School of Liberal Arts, *Detroit, Michigan* 48202 (DMR72-00181 A01)

Investigations of the microwave properties of metals begun under NSF Grant GH-39825 will be continued. The transmission

of microwaves at 80GHz through thin plates of pure metal under conditions of varying magnetic field strength, orientation, and temperature will be measured. A careful study of spin wave excitations in the conduction electrons of aluminum will be carried out for samples of optimum thickness and orientation to obtain accurate measurements of the relevant Landau Fermi-Liquid Parameters. The Conduction Electron Spin Resonance (CESR) and possible spin wave excitations of copper and silver will be examined to obtain information at high microwave frequencies on g-anisotropy of the Fermi surface and exchange interactions among the conduction electrons. Finally, an extensive study of the alkali metals will be made, including a search for new physical effects which should occur only at millimeter microwave frequencies.

SUPPORTED BY U.S. Natl. Science Foundation

8.0030, ION IMPLANTATION IN PEROVSKITE TYPE FERROELECTRICS 14313-P
R. GERSON, Univ. of Missouri, School of Arts & Sciences, *Rolla, Missouri* 65401 (DA0E9273; DAAG29 77 G0001)

To investigate the effect of ion implantation of ferroelectric crystals such as some of the standard barium titanate type materials and some electrooptic materials like lithium niobate, lithium tantalate and bismuth titanate. Relevance - there is a growing body of information which suggests that a good deal of the standard ferroelectric, piezoelectric, and pyroelectric properties are, either in whole or in part, dependent on the surface properties of these materials. There are some auguments that suggest that modification of these surfaces would provide a whole new class of devices. Piezoelectrics are used as fuse initiators and pyroelectrics are used as IR detectors.

A broad range of perovskite-type ferroelectric materials will be implanted with hydrogen, oxygen, helium and p and n type metallic dopants. The properties of these materials will then be studied to evaluate some of their device potential.

ADDENDA: Supporting agency address is: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0031, ATOMIC LIFETIME AND OSCILLATOR STRENGTH MEASUREMENTS
L.C. BALLING, Univ. of New Hampshire, School of Liberal Arts, *Durham, New Hampshire* 03824 (PHY74-05548 A02)

A pulsed dye laser is used to make direct measurements of atomic excited-state lifetimes and to make relative measurements of the oscillator strengths for certain weakly allowed optical transitions. The excited states of Li, Mg, Ca, Sr, Al, etc., are populated by a laser pulse, and the decay of the population is observed by means of the fluorescence from the excited state, or by the absorption by the excited state atoms of resonance radiation from an appropriate lamp. Measurements are also underway for the oscillator strengths of the weakly allowed electric quadrupole transitions between the ground state and first excited state in Na, K, Rb and Cs relative to the well-known oscillator strengths for the alkali D-1 lines.

This work is a continuation of that currently supported by Foundation grant number GP-43615 (PHY74-055487).

SUPPORTED BY U.S. Natl. Science Foundation

8.0032, APPLICATIONS OF MANY-BODY THEORY
P.W. ANDERSON, Princeton University, Graduate School, *Princeton, New Jersey* 08540 (DMR76-00886 A01)

A program of application of concepts of many-body theory to understanding the properties of materials important in areas of science from the physics of neutron stars to semiconductor technology will be pursued. The main areas of present concern are: (1) Theory of amorphous and random materials. Here it is hoped to exploit two recent breakthroughs: (a) a new model for the electronic structure of glassy semiconductors, which promises to resolve a number of experimental paradoxes in this field; (b) a new theory of 'spin glasses', alloys with random magnetic interactions. Both should open avenues towards the conceptualization of this field. (2) Physics of neutron stars. The dense baryon gas deep inside a neutron star probably manifests a wide range of new physical phenomena where modern quark theories may be the best approach to the equation of state and other properties. (3) Self- consistent theory of the 'Anderson model' of local states near band gaps and edges. New ideas have been proposed to discuss a variety of technically important systems: recombination centers, neutral complexes in enzymes, catalytic processes at surfaces.

SUPPORTED BY U.S. Natl. Science Foundation

8.0033, THEORETICAL PHYSICS
A.S. WIGHTMAN, Princeton University, Graduate School, *Princeton, New Jersey* 08540 (PHY76-80958)

Investigation of a series of problems in quantum field theory, statistical mechanics and general mathematical physics will be carried out. The work will include the extension of existing results on Yukawa interactions in constructive field theory, further development of the general theory of gauge models, both in the context of quantum electrodynamics and non-Abelian gauge theories, and further refinement of theorems on the inconsistency of theories of particles of spin greater than or equal to 3/2 in external fields.

This work represents a continuation of that currently supported by Foundation grant PHY74-22844 A01.

SUPPORTED BY U.S. Natl. Science Foundation

8.0034, A SEARCH FOR WEAK, NEUTRAL CURRENTS BY THE STUDY OF NEUTRINO INTERACTIONS AT BNL
R.L. COOL, Rockefeller University, Graduate School, *New York, New York* 10021 (EY-76-C-02-2232A)

A search is under way for evidence for the presence of neutral, weak currents in the interaction of neutrinos with nucleons. One evidence for such currents is the presence of interactions induced by neutrinos with no mu-meson among the final-state reaction products. Many currently interesting gauge theories which attempt to unify weak and electromagnetic interactions predict the existence of such currents. We are particularly interested in the measurement of the ratio of neutral-current to charge-current events with a neutral pion in the final state. This ratio can be used to differentiate among various gauge theory models. We plan to measure this ratio both for neutrino and antineutrino interactions.

Part 2 of 6.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0035, ELECTRON-POSITRON PAIRS & ELECTRONS AND PI-MESONS WITH LARGE TRANSVERSE MOMENTUM PRODUCED IN P-P COLLISIONS (ABBREV)
R.L. COOL, Rockefeller University, Graduate School, *New York, New York* 10021 (EY-76-C-02-2232A)

Measurements of the energy of electrons (positrons) and photons near c.m.s. angles of 90 degrees allow a search for new massive particles which can decay via (e nu), (e-nu), (e e-), (e gamma), (e- gamma) and (neutral pion neutral pion). Two such particles have recently been discovered at SLAC and BNL. Their production in strong interactions and their decay properties will be investigated. Theoretical models also predict the existence of other fundamental particles in the ISR mass range, for example, the intermediate vector bosons which would mediate weak interactions. Measurement of the inclusive production cross section for neutral pion-mesons with large transverse momentum and of correlations with positive and negative pions and neutral pion mesons allows a study of the small-distance behavior of strong interactions.

Part 3 of 6.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0036, DRIVEN AND SPONTANEOUS DISSOCIATION OF MOLECULES 14473-P
E. MONTROLL, Univ. of Rochester, School of Arts & Sciences, *Rochester, New York* 14627 (DA0F8902; DAAG29 77 G0060)

To investigate theoretically the nonlinear dynamics of the dissociation of medium-sized molecules as well as the nonlinear dynamics of the generation of shock waves in crystalline solids. Relevance - the proposed work is directly relevant to on-going work on energetic processes in metastable materials at Picatinny Arsenal, to shock wave propagation studies at BRL, and to molecular dynamics calculations on metals at AMMRC. It also has broader potential relevance to areas involving chemical reactions, phase transitions, propagation of heat through solids, etc.

Both classical and quantum mechanical analytical (rather than numerical) approaches developed by the P.I.'s will be used - specifically, series expansions will be used that are so rapidly convergent that a few analytic terms will suffice. Also, we shall exploit high-speed computers to do bookkeeping on the terms so as to go to extremely high orders and accuracy.

ADDENDA: Supporting agency address is: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0037, ADVANCED TECHNIQUES IN ATOMIC PHYSICS
H. METCALF, State University of New York, School of Arts & Sciences, *Stony Brook, New York* 11790 (PHY75-13147 A01)

Support is provided for experiments in various states of progress. The first is a study of the phenomenon of coherence narrowing using the temporal resolution available with pulsed lasers. It is expected to elucidate several aspects of this phenomenon using pulsed, tunable dye lasers to excite atoms in vapors of various densities and using fast photodetectors to observe the fluorescence. The second major experiment is a precision measurement of the fine structure in n equals 3 helium. This also uses the time resolution available from the pulsed laser. Because observations are restricted to atoms which have been in their excited states for a predetermined period of time, interference effects are observed which enable much higher precision of measurement. The third major experiment is a measure of the Lamb Shift in doubly ionized lithium.

SUPPORTED BY U.S. Natl. Science Foundation

8.0038, GENERAL RELATIVITY
J.N. GOLDBERG, Syracuse University, School of Arts & Sciences, *Syracuse, New York* 13210 (PHY74-15246 A03)

Theoretical research in gravitation initiated under NSF grant PHY74-15246 A01 will be continued. Among the topics in classical and quantum gravitation theory to be pursued are: Quantum Theory of Gravity; (1) Theory of measurements; (2) Hamilton-Jacobi Theory. Phase integral quantization; (3) Null surface quantization; (4) Twistor Theory; (5) The relativistic string. Classical General Relativity; (1) Asymptotic flatness and modification of the 'Peeling Theorem'; (2) Equations of Motion; (3) Positivity of Energy.

SUPPORTED BY U.S. Natl. Science Foundation

8.0039, ELECTROMIGRATION IN METALS
H.B. HUNTINGTON, Rensselaer Polytechnic Inst., School of Science, *Troy, New York* 12181 (DMR76-81239)

An experimental program to study electromigration in metal systems will be continued. In addition to the general importance that this phenomenon holds for the purification of metals and for the stability of electronic components, the particular objects of this investigation concern the relevant problems of the motion of hydrogen in metals and the mechanisms for fast diffusion in metals. Future work will include measurements on nickle in lead and on the noble metals in tin. Electromigration measurements for the hydrogen isotopes in copper are under way. Other gases in the noble metals and also the hydrogen isotopes in palladium will be investigated. New projects for the program are (1) critical experiment to look at the electromigration of Cd in lead for which a large positive Z^* is predicted, (2) redesign of the electromigration gas apparatus and (3) the application of the electromigration technique to a certain well-characterized amorphous metal product as a probe to determine which constituents may be mobile below the devitrification temperature.

This is a continuation of research supported under DMR72-03270 A01.

SUPPORTED BY U.S. Natl. Science Foundation

8.0040, HIGH-ENERGY PHYSICS STUDIES
T.A. ROMANOWSKI, Ohio State University, School of Math. & Phys. Scis., *Columbus, Ohio* 43210 (EY-76-C-02-1545)

EXPERIMENTAL PROGRAM: We will continue the following experiments at the ZGS: a study of leptonic decays of polarized sigma minus (E-347) and a search for new resonances in meson spectroscopy (E-420). Data analysis from the experiment on the rho-omega interference (E-380 ZGS) and omega production (E-337 ZGS) will proceed. The Fermilab experiment on the charm search (E-366) finished data taking and the analysis of the results continues. Formulation of a new research plan at Fermilab is in progress. We will maintain the development of the drift chamber technology. Improvements in the data acquisition capabilities of the two on-line computer systems PDP-15 and SPc-16 will be implemented.

THEORETICAL PROGRAM: Theoretical investigations proposed for the coming year can be broadly summarized as follows: study of the quark models with suitable admixture of color and flavors, the quark confinement problem, calculation of the production cross section of charmed mesons and finally the theory and phenomenology of narrow resonances. Phenomenology of weak interactions and the general validity of patron model will be investigated.

RESULTS: Results from our research in experimental and theoretical high energy physics program were published and a list of publications is appended.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0041, MATERIAL SUPPORT TECHNOLOGY - RADIATION DAMAGE PROCESSES IN SILICON
G.D. WATKINS, Lehigh University, School of Arts & Sciences, *Bethlehem, Pennsylvania* 18015 (DN775012; N00014-76-C-1097)

The effects of radiation in semiconductors produces degradation in the performance of electron devices in Navy electronic systems. Many of the damage processes caused by ionizing radiation and the interaction with residual impurities are not understood. This study will lead to predictions for radiation effects and also to understanding of the effects of impurities in silicon.

Combinations of various experimental techniques will be applied to the study of point defects produced in silicon by high-energy electron irradiation. Electron paramagnetic resonance (EPR), and transient and photocapacitance measurements will be made, in situ, on specimens bombarded by Mev electrons. Cryogenic temperatures will be used to immobilize certain defect kinetics, thus permitting easier separation of the many possible effects and interactions. The effects of charge state and electronic excitation on the stability, mobility, and reaction kinetics of various defects will be studied. Attempts will be made to understand why the electron damage production rates are so different between N and P type silicon. Initial focus will center on the vacancy and its various charge states, the interstitial, and the interstitial- impurity interaction. The stability of the trapped interstitial will be investigated.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0042, CALCULATIONS OF SURFACE PROPERTIES OF SOLIDS
F.W. DEWETTE, Univ. of Texas, School of Arts & Sciences, *Austin, Texas* 78712 (DMR75-18492 A01)

A program of theoretical investigation of a number of problems in the structure and lattice dynamics of crystal structures will be completed, with the aim of developing basic knowledge of surface properties which is of intrinsic interest as well as extrinsically in support of materials science and technology. Three principal themes characterize the work proposed: (1) Investigation of intrinsic phenomena of structure and vibrations of well-characterized simple, but useful, crystal surfaces--such as molecular crystals, ionic crystals and metals; (2) Study of the consequences such intrinsic phenomena have for experimental

methods used for investigating crystalline surfaces; such as infrared adsorption, and low-energy atom and ion scattering and thermodynamic measurements; (3) Investigation of the influence of surface structure and dynamics on the interaction of 'foreign' atoms with crystal surfaces in cases in which the foreign atoms are in some sense bound to the surface--as in physical adsorption, desorption, etc.

This is a continuation of research supported under DMR-7518492.

SUPPORTED BY U.S. Natl. Science Foundation

8.0043, ATOMIC AND MOLECULAR PHYSICS
C.B. COLLINS, Univ. of Texas, Graduate School, *Dallas, Texas* 75230 (INT76-18982)

To date, this project has introduced the concept of hybrid resonances in multiphoton spectroscopy, demonstrated a technique suited for the examination of diffuse molecular bands, and pointed a direction toward discovery, identification and analysis of repulsive and weakly bound states of alkali molecules. In the forthcoming period, work will be directed to quantitative studies significant to broad areas of plasma chemistry, laser physics, and aeronomy, and specifically to applied physics efforts in e-beam lasers and photochemistry. Structure and properties of repulsive states of alkali-bearing molecules will be defined, primarily by multiphoton spectroscopy. The order of occurrence of repulsive states of cesium, not expected in earlier theory, will be further delineated by examination of the dissociative part of the cesium spectrum. The work will be extended to rubidium, and subsequently applied to cesium and rubidium combinations with inert gases in order to obtain comprehensive spectroscopic data on the excimer states of these alkali-inert gas molecules. Finally, collisional effects will be studied by variation of the time delay between laser excitation of molecular transition and laser detection of the dissociation fragments.

This work will be conducted in cooperation with Iovitzu Popescu, et al, Institute of Physics, Bucharest, Romania. Experimental work on cesium will produce quantitative values of line strengths and potential curves for comparison with developing theory. The evolving theory itself is mainly a Romanian contribution, and will be numerically evaluated on U.S. computers. Application will then be directed to fine structure effects and subsequently extended to additional alkali systems.

SUPPORTED BY U.S. Natl. Science Foundation

8.0044, TOPOLOGICAL STABILITY AND HIGH-TEMPERATURE PLASMA CONFINEMENT
J.H. GARDNER, Brigham Young University, School of Math. & Phys. Scis., *Provo, Utah* 84602 (BYU-410-95-197)

DESCRIPTION: A novel approach to the magnetic confinement of high- temperature plasmas is being investigated. The principles of structural stability, as developed in the mathematical field of topology, give new insight into the necessary conditions to achieve the long confinement times necessary for plasma fusion. These concepts are being incorporated into the design of a toroidal device called the topolotron. It is the only project at present which adds the concepts of structural stability to the commonly included stability criteria. It is anticipated that this investigation will provide some of the information necessary for the development of a practical fusion device. Theoretical analyses of the stability characteristics are in progress. Computer simulation of plasma behavior has been performed. An experiment to examine these ideas is currently in the construction stage.

SUPPORTED BY Brigham Young University - Provo, Utah

8.0045, THERMODYNAMIC AND TRANSPORT PROPERTIES OF INTERSTITIAL HYDROGEN ISOTOPES IN METAL SYSTEMS
J.S. BROWN, Univ. of Vermont St. Agr. Col., School of Arts & Sciences, *Burlington, Vermont* 05401 (EY-76-S-02-3551)

Studies of electronic and transport properties of liquid transition metals Ti and Pd are in progress, using phase-shift methods applied to various muffin-tin-potentials. We are attempting a liquid metal band structure calculation to determine the electronic density of states N(E), using linear muffin-tin orbital methods. In addition studies of the superconducting transition temperature Tc of non-stoichiometric hydrides and deuterides of Pd are in progress, using recently published inelastic neutron scattering data on their phonon spectra, and using information available from recent theoretical studies published in the literature. In addition we are studying the use of Compton profiles to study the nature of the electronic charge distribution of H and D in Pd.

RESULTS: Calculations of resistivity in liquid Pd using a number of approximations of physical interest have recently been accepted for publication. In addition, a study of the structure factor in liquid Ti has been accepted for publication. Calculations of Tc for stoichiometric PdH and PdD have recently been completed using various electron-phonon decoupling approximations and recent phonon spectrum data.

SUPPORTED BY U.S. Energy Res. & Dev. Admin - P.R.D.

8.0046, ISOLATED ATOMIC PARTICLES AT REST IN FREE SPACE
H.G. DEHMELT, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (PHY76-11176 A01)

Zero Doppler shift high-resolution coherent spectroscopy experiments on free atomic systems by means of storage techniques are proposed. Specifically (g-2)-resonances of a single free electron and positron are to be investigated. Experimental techniques for storage, refrigeration and manipulation of free ions and electrons are to be refined. Ultimately studies in the 10 to the 15th power Hz region on an atomic ion brought to complete rest by laser scattering may be possible.

This work is a continuation of that currently supported by Foundation grant PHY-7413727 A01.

SUPPORTED BY U.S. Natl. Science Foundation

8.0047, MOSSBAUER/MATRIX ISOLATION STUDIES OF METAL ATOMS & DIMERS - IMPURITY EFFECTS ON ORDERING OF MAGNETIC CHAIN SYSTEMS (ABBREV)
P.A. MONTANO, West Va. University, School of Arts & Sciences, *Morgantown, West Virginia* 26506 (DMR76-11113)

This research consists of two parts. In the first part, matrix isolation techniques and the Mossbauer effect are used to study atoms and molecular compounds of 121Sb (antimony) and 151Eu (europium). The purpose of this investigation is to obtain more accurate values of the change in mean-square nuclear radius. Also, the internal magnetic field at the 151Eu nucleus imbedded in a solid rare gas is being determined, and is to be compared with the value obtained from atomic beam measurements. The purpose of the measurement is to determine the amount of matrix perturbation. The major segment of this work is a systematic study of the iron-3d transition metal dimers isolated in a rare gas solid. The purpose is to obtain information about the interaction between two transition metal atoms and the systematic participation of the d- and s-electrons in the bonding. Mossbauer measurements in the presence of a high external field will permit the study of the dependence of the internal field at the iron nucleus on the neighboring 3d metal atom. These measurements should contribute eventually to the understanding of the magnetic properties of the iron-3d metal alloys.

In the second part, the effects of impurities on the three-dimensional ordering of magnetic chain systems is being studied. The thermodynamic and magnetic behavior of mixtures of (CH3)4 NMnCl3 (TMMC), (CH3)4 NNiCl3 (TMNC), and of CsNiCl3-CsMgCl3 are being measured. These compounds can be described by a classical Heisenberg model over a wide range of temperatures. For mixtures of RbFeCl3-RbFeBr3, the Mossbauer effect will be used to determine the transition temperature.

SUPPORTED BY U.S. Natl. Science Foundation

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, PLANETARY RESEARCH
E.C. MORRIS, U.S. Dept. of the Interior, Geological Survey, *Flagstaff, Arizona* 86001 (9580-00730)

The major divisions of Planetary Research in FY 77 will be (1) Planetary Data Analysis and (2) Geologic Support for Planetary Missions. The overall objectives and goals of the project will be the reduction of photographic data received from planetary probes to produce geologic maps of the surfaces of the planets and to investigate geologic features and processes that are of special importance in the shaping of planetary surfaces and to provide geologic support for future planetary missions and to increase the interpretability of available planetary data by conducting selective experimental and terrestrial geologic studies. The approach may vary as mission schedules and goals change along with the state of understanding of planetary surface processes.

The major tasks during FY1977, some of which are continuations of last year's work, under the general headings will be: 1) Systematic Geologic Mapping of Mars (D.H. Scott); 2) Geologic Application of Venus and Mars Radar data (H. Masursky, G.G. Schaber); 3) Aeolian Studies (J.F. McCauley); 4) Erosional Landforms on Mars (B.K. Lucchitta); 5) Multi-ring basins (J.F. McCauley); 6. Image processing research (L.A. Soderblom); 7) Time-scales of the terrestrial planets (L.A. Soderblom); 8) Radar backscatter modeling (G.G. Schaber).

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0002, REGIONAL LUNAR SYNTHESIS
D.H. SCOTT, U.S. Dept. of the Interior, Geological Survey, *Flagstaff, Arizona* 86001 (9580-01329)

Structural and volcanic features on the Earth, Moon, and other planets will be studied and data compiled on maps and cross sections relating to formational processes, time and modes of origin, and correlation with geophysical and geochemical information. The structural deformation that has occurred during later stages in the history of the Moon will be measured by topographic deviations of mare surfaces from regional planar attitudes. Similar studies of smaller- scale lunar landforms such as ridges and rilles will be compared to similar features on the Earth and other planets. Comparative studies of lava flows and volcanoes on Earth, and the planets will be made for evidence of compositional variations and differentiation processes. Investigations of the rheology of lunar flows are planned to obtain estimates of yield strengths and to provide semi-quantitative analyses of processes associated with flows of volcanic and impact origin and debris flows on planetary surfaces.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

10.0003, HYDRODYNAMIC STUDIES OF STARS - THE NOVA OUTBURST AND FG SGE
S.G. STARRFIELD, Arizona State University, School of Liberal Arts, *Tempe, Arizona* 85281 (AST73-05271 A02)

Research will continue on the origins of the nova phenomenon on a number of fronts. Studies will be made of the evolution of white dwarf stars in order to study the behavior of slow nova models as a function of the white dwarf star mass. Attempts will be made to model transient x-ray sources. It is possible that such events are the result of thermonuclear runways in the envelopes of neutron stars. Studies will be made of the effect of accretion of matter onto neutron stars. The pulsational properties of evolved white dwarf stars will be examined. Other work to be carried out will include studies on isotope production during a nova, x-ray emission from a nova, two-dimensional hydrodynamic studies of the nova outburst, and the influence of turbulent convection on stellar evolution and nucleosynthesis. This is the second year of the two year continuing grant AST 73-05271A01.

SUPPORTED BY U.S. Natl. Science Foundation

10.0004, INFRARED PHOTOMETER AND SECONDARY MIRROR MODULATION SYSTEM FOR A LARGE MULTIPLE MIRROR TELESCOPE
W.F. HOFFMAN, Univ. of Arizona, Steward Observatory, *Tucson, Arizona* 85721 (AST76-21732)

A multiple mirror telescope (MMT) is in the final stages of construction on Mt. Hopkins, an 8,650-foot mountain south of Tucson. It has been funded by the University of Arizona and the Smithsonian Astrophysical Observatory. The telescope is equivalent to a conventional telescope 4.5 meters in diameter but uses six 1.8 meter diameter mirrors working together. An active optics control system combines the beam from all six mirrors continually adjusting each one to maintain optimum alignment.

A multi-band infrared photometer will be built for use on the MMT. This project will include the development of a secondary modulation system necessary to take full advantage of the large aperture and low infrared background of the MMT for astronomical observations.

SUPPORTED BY U.S. Natl. Science Foundation

10.0005, EVALUATION AND IMPROVEMENT OF ACTIVE OPTICS ELEMENT IN A LARGE MULTIPLE MIRROR TELESCOPE
W.F. HOFFMANN, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (AST76-20822)

A multiple mirror telescope on Mount Hopkins, a 8,650 foot mountain south of Tucson, Arizona, is in the final stages of construction. It has been funded by the University of Arizona and the Smithsonian Astrophysical Observatory. It is equivalent to a conventional telescope 4.5 meters in diameter but uses six 1.8 meter diameter mirrors working together. The crucial element is the active optics control system which combines the beams from all six mirrors, continually adjusting each one to maintain optimum alignment.

A three year program of testing and evaluation of the active optics system will be carried out at the University of Arizona. The performance of the optical system will be critically evaluated. The system will be improved wherever possible. The limiting factors in the telescope mechanics and in the earth's atmosphere will be identified. The results will be analyzed with respect to the application of the multi-mirror approach for the construction of new very large aperture optical and infrared telescopes.

SUPPORTED BY U.S. Natl. Science Foundation

10.0006, CONTINUED DEVELOPMENT OF INFRARED SPATIAL INTERFEROMETRY
F.J. LOW, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (AST77-01261)

Spatial interferometry offers the hope of achieving angular resolution ten times better than conventional observations in the infrared region of the spectrum. Such improvement will allow detailed comparisons with observations at visible and millimeter wavelengths which are vital to understanding the physical processes involved in a wide range of celestial objects.

A spatial interferometer has been constructed and successfully used at the University of Arizona. Using this instrument the limitations imposed by the earth's atmosphere will be studied in various wavelengths ranging from 2 to 20 microns. The instrument will be improved by the addition of a second baseline to more than double the instrumental efficiency. Methods of increasing the usable baseline, and hence, improving the obtainable resolution will be explored.

Observations will be made of circumstellar dust shells, stars and planetary systems in the process of formation and the nuclei of energetic galaxies.

This is a continuation of work supported under NSF grant MPS 75- 00530.

SUPPORTED BY U.S. Natl. Science Foundation

10.0007, CLOSE BINARY STARS
M. PLAVEC, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (AST74-04194 A03)

Support for an additional 12-month period will permit continuation of a broad-scale attack on problems of close binary stars, which form a major element of the stellar population. In addition to furnishing fundamental data for stars, they give rise to such striking phenomena as novae and X-ray stars, and study of their evolution provides a fascinating variety of problems. The

principal tools to be employed are spectrographic observations and the development of theoretical models. Emphasis during this period will be as follows: Observations and analysis - early-type detached systems, Algol systems, systems with H and K emission, and Be stars and shell stars. Model development - inclusion of more generalized assumptions than heretofore for evolution through mass transfer, including the evolution of the mass-accreting components; models of mass flow, to be tested by comparison with profiles of spectral lines.

Prior support was by NSF grant AST 74-04194 A02.

SUPPORTED BY U.S. Natl. Science Foundation

10.0008, A COSMOLOGICAL STUDY OF VERY FAINT GALAXIES

J.B. OKE, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (AST76-22111)

The present survey program to find very distant clusters of galaxies is about 75 percent complete. The only fields not yet properly surveyed are those in the north galactic cap, which must be observed in the spring when observations are difficult because of the weather. Since the first paper on the Hubble relation was published, 38 galaxies in very faint clusters have been observed; many of these have red shifts greater than 0.40. A study of a carefully selected group of Abell clusters has been made to provide better statistics at the bright end of the Hubble diagram. A study of evolutionary effects in galaxies indicates that color changes are very small; changes do occur, however, in spectral features. Research will continue on stellar synthesis of galaxy spectra.

The major observational thrust will be to complete the survey in the next two years and to obtain red shifts and spectral characteristics for all the clusters found in the survey. Emphasis will be placed on SIT spectrograph observations because they can be made quickly and provide the resolution needed to study spectral features for evolutionary effects with distance. Theoretical research will be done on such problems as the swallowing up of small galaxies by large ones and the whole subject of the 'hidden mass' in galaxies and clusters.

This action provides additional funding and extends the duration of the grant AST 7423453 A01 for 12 months.

SUPPORTED BY U.S. Natl. Science Foundation

10.0009, SOLAR MAGNETIC AND VELOCITY FIELDS

R.F. HOWARD, Carnegie Inst. of Washington, *Washington, District of Columbia* 20005 (AST75-19756 A01)

Support is for the second increment of a two-year continuing grant to study the magnetism and motions on the sun using the 150-foot tower telescope at Mt. Wilson with recently improved optics and instrumentation. The researches planned include: 1. Study of the large-scale distribution of weak magnetic fields on the solar surface during the current minimum of the sunspot cycle. It is expected that careful observations of the distribution of magnetic flux during minimum will aid in understanding the nature of the solar cycle. In particular, the puzzling monopole behavior of the sun, seen at the last minimum in the Mt. Wilson magnetograph results and also in the interplanetary magnetic field measurements, will be examined with the improved instrument through the present minimum period. 2. Study of the large-scale circulation of the solar atmosphere and the variation of the solar rotation with latitude as important parameters in any theory of solar activity. It is well established that the rotational velocity of the sun varies with time, both on a short-term and long-term basis, with some evidence of a variation of rotational velocity with phase in the solar cycle.

The data handling system used with the telescope will be improved by the addition of a second data channel which will permit the provision of a wavelength standard for calibration of the velocity measurements to an absolute system.

SUPPORTED BY U.S. Natl. Science Foundation

10.0010, THE CHROMOSPHERES AND CIRCUMSTELLAR ENVELOPES OF RED GIANT STARS

A.M. BOESGAARD, Univ. of Hawaii, School of Arts & Sciences, *Honolulu, Hawaii* 96822 (AST76-81608)

Two projects will be carried out in order to determine the nature of the physical conditions in circumstellar envelopes of stars. There will be a study of the ultraviolet emission lines of singly ionized iron in red M stars. The details of these line profiles in two M giants with similar surface temperatures but different iron line emission intensities will elucidate the processes of formation of circumstellar envelopes in red giant stars. A computer program will model the emission features, and comparison of the predicted and observed emission lines will enable characteristics such as the temperature-density distributions and mass motions in the gas to be determined. A study will be made of the circumstellar shells surrounding young T Tauri-type stars. The ultraviolet spectra of these stars are rich in emission lines found in red giants. Information about the physical conditions in the envelopes and nebulosities surrounding these stars will be obtained by the same techniques used for the red giant stars. It is expected that the line profile analysis will enable one to distinguish between mass outflow and mass infall models for T Tauri stars. This is the first year of a two year continuing grant.

This is a continuation of work previously supported by NSF Grant AST 73-04840A01.

SUPPORTED BY U.S. Natl. Science Foundation

10.0011, THE PHYSICAL PROPERTIES AND EVOLUTION OF GALACTIC NEBULAR COMPLEXES

H.R. DICKEL, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (AST75-22208 A01)

Fundamental to our understanding of the problem of star formation is the determination of the physical conditions in nebular complexes out of stars which are forming. In particular, the size, velocity, structure and variations in optical depth, and excitation temperature of both the overall cloud and other compact components of galactic nebulae are basic parameters in the processes involved. Several galactic sources, such as the DR21-W75 complex in Cygnus, which contain nebulae in various stages of evolution will be studied. Maps of CO12, CO13, H2CO and visual extinction will be compared with the large-scale distributions of other molecules and the far-infrared emission to determine the nature of the dust clouds. They will also be related to the embedded regions of active star formation such as the masers and near-infrared sources. The excitation conditions in associated ionized hydrogen (HII) regions will be investigated via optical observations of their forbidden line radiation. The results will be used to infer possible interactions between the optical nebulae and the molecular clouds.

This is a continuation of work previously supported by AST 7522208.

SUPPORTED BY U.S. Natl. Science Foundation

10.0012, SOLAR WIND STUDIES USING THE COCOA CROSS RADIOTELESCOPE

W.M. CRONYN, Univ. of Iowa, School of Liberal Arts, *Iowa City, Iowa* 52240 (ATM73-06559 A04)

This grant continues the solar terrestrial research program to study dynamic solar wind features associated with, and delineated by, interplanetary scintillation (IPS) activity of natural celestial radio sources. The activity is measured using the University of Iowa COCOA Cross radio telescope, an instrument designed specifically for IPS work. Its operating frequency (34 MHz) and the large, electrically steerable collecting area (72,000 square meters) have made it possible to take daily synoptic IPS measurements on far more sources (approximately 130 at present) over a larger range of ecliptic coordinates than would be possible on any other telescope in the world.

The results of previous work have established the technical and scientific capabilities of the instrument through observations of numerous recurrent magnetic-sector-boundary-associated IPS enhancements and several transient events corroborated by spacecraft particle data. This grant will expand the data base and observational expertise to more effectively utilize the COCOA Cross IPS observations as a sensitive and unique tracer of solar wind turbulence at ecliptic latitudes not presently accessible to spacecraft. IPS measurements from the COCOA Cross will also serve as additional empirical data to help deduce solar wind physical processes in conjunction with in situ spacecraft measure-

ments. Eventually it is hoped that it will be possible to monitor the solar wind from the ground at a cost significantly less than that of the equivalent spacecraft system.

SUPPORTED BY U.S. Natl. Science Foundation

10.0013, COSMOLOGY, RELATIVITY, AND RELATIVISTIC ASTROPHYSICS

W.H. PRESS, Harvard University, Graduate School, *Cambridge, Massachusetts* 02138 (PHY76-14852)

A program of theoretical research in cosmology, relativity, and relativistic astrophysics will be initiated. Among the topics to be investigated: 1. Fluid configurations relevant to galaxy formation; 2. Possible turbulent instabilities in some cosmologies; 3. Strong, spherical gravitational waves; 4. Clusters of galaxies and their cosmic significance; 5. Irreversibility in the production of gravitational waves; 6. Models for chaotic gravitational collapse; 7. Properties of rotating black holes; 8. Polarization of quasar radiation; 9. Gravitational radiation from newly fissioned stars.

SUPPORTED BY U.S. Natl. Science Foundation

10.0014, INFRARED ASTRONOMY

W.A. STEIN, Univ. of Minnesota, School of Liberal Arts, *Minneapolis, Minnesota* 55455 (AST76-21459)

Research directed at obtaining observational results primarily at infrared wavelengths from one micron to millimeter and with the interpretation of these results on a wide variety of astronomical objects will be carried out. Investigations will cover the composition of solid particles in circumstellar and interstellar space, the identification and interpretation of characteristics of objects discovered in infrared sky surveys and the nature of high energetic objects such as QSOs, BL Lac objects and the nucleus of Seyfert Galaxies. Most of the power emitted by many of these objects (galactic and extragalactic) is radiated at infrared wavelengths. The study of this radiation at moderate spectral resolution will lead to identification of discrete spectral features. The interpretation of the spectral flux distribution and variability will lead to further understanding of physical conditions and will complement results obtained by observations at radio, optical and x-ray wavelengths.

SUPPORTED BY U.S. Natl. Science Foundation

10.0015, OBSERVATIONAL STUDIES OF CLOUDS INTERACTING WITH NASCENT STARS

J.L. PIPHER, Univ. of Rochester, School of Arts & Sciences, *Rochester, New York* 14627 (AST75-22901 A01)

The Orion Nebula is an area where star formation is taking place at the present time. This region is an immense complex of (1) glowing gas around newly formed massive stars, and (2) dark clouds where there may be star formation occuring at the present time. In these regions one sees proto-stars by means of the infrared radiation emitted from the dusty shells surrounding the infant star. These shells emit strongly at radio wavelengths because of water molecules in the shell. These are referred to as H2O masers. Observations will be made of these regions in the infrared. Objects to be examined include compact HII regions, molecular clouds, and infrared stars (including the maser sources). These observations will be combined with optical and radio observations of the same objects and will provide us with a means of investigating the conditions for star formation, the interactions of nascent stars with the interstellar medium, and the energetics and physical conditions involved in the system. This is a renewal of work originally funded under NSF Grant AST 75-22901.

SUPPORTED BY U.S. Natl. Science Foundation

10.0016, EXTRAGALACTIC AND SOLAR SYSTEM RADIO ASTRONOMY

J.N. DOUGLAS, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (AST76-01883 A01)

The University of Texas Radio Astronomy Observatory (UTRAO) program in extra-galactic astronomy, and the supplementary programs in instrumentation and synoptic monitoring of Jupiter will be continued.

The extra-galactic radio astronomy research has three phases: Continuation of the Texas Sky Survey. Accurate (plus or minus 1') positions, flux density, structure and variability data are being obtained at 380 and 335 MHz for all sources north of -35 degrees declination and brighter than 0.25 Jansky. The ultimate catalogue will contain about 50,000 sources; at the beginning of the proposed support period observations will be 2/3 complete, and during the proposed support period the catalogue section covering 13.6 degrees to 40.6 degrees declination (containing about 13,000 sources) will be published and observing brought to 80% of completion.

Spectroscopic and photometric observations of selected large samples will be done.

Identification of radio sources will be made from the survey with optical objects from the NGS-Palomar Sky Survey, using our accurate radio positions and accurate optical positions measured with a computer- interactive laser measuring engine. Experience to date shows about 45% of radio sources to have optical counterparts within 5', having an identification reliability higher than 90%. The entire survey is expected to produce about 22,000 optical identifications, an order-of- magnitude increase over what is now available in the literature.

This is a continuation of work previously supported by NSF grant AST76-01883.

SUPPORTED BY U.S. Natl. Science Foundation

10.0017, PLANETARY MINERALOGY

P. TOULMIN, U.S. Dept. of the Interior, Geological Survey, *Herndon, Virginia* 22092 (9710-00954)

The project is concerned with mineralogical studies of extraterrestrial planetary bodies by theoretical and remote analytical methods. Principal emphasis is on the analysis of Martian surface materials by means of two instruments on the Viking Mars Landers: an X- ray fluorescence spectrometer for elemental analysis of surface samples, and a gas chromatograph-mass spectrometer; the latter, in addition to its primary applications to the organic analysis of the Martian 'soil' and the analysis (by MS alone) of the Martian surface atmosphere, is providing useful data on volatile inorganic constituents of the Martian surface. Laboratory simulations will be an important activity in FY77.

SUPPORTED BY U.S. Dept. of Interior - Geological Survey

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VOLUME 15 NUMBER 18/ SEPTEMBER 23, 1977

Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N77-27064# Committee on the Judiciary (U. S. Senate).
CIVIL AERONAUTICS BOARD PRACTICES AND PROCEDURES
Washington GPO 1975 263 p refs Rept. of the Subcomm. on Administrative Practice and Procedure of the Comm. on the Judiciary, 94th Congr., 1st Sess., 1975
(GPO-60-316) Avail: Subcomm. on Administrative Practice and Procedure

The recommendations, conclusions, and analyses arising from the comprehensive 1975 investigation of the Civil Aeronautics Board's practices and procedures are presented. Topics discussed include: competition, route policy, fare policy, capacity restricting agreements, enforcement, consumer protection, and required legislation. Author

N77-27065# Civil Aeronautics Board, Washington, D.C.
REPORT TO CONGRESS, FY 1976 Annual Report, 1 Jul. 1975 - 30 Jun. 1976
Jan. 1977 151 p refs
Avail: NTIS MF A01; SOD HC $1.75

Route licensing and rate regulation activities of the Civil Aeronautics Board during FY 1976 are reported. Economic enforcement, consumer affairs, and community and congressional relations are discussed along with legislative developments and international air transportation. J.M.S.

N77-27066# Committee on Science and Technology (U. S. House).
THE FUTURE OF AVIATION
Washington GPO 1976 738 p refs Hearings before Subcomm. on Aviation and Transportation on R and D of the Comm. on Sci. and Technol., 94th Congr., 2d Sess., no. 82, 4-6, 11-13, 18 and 20 May 1976
(GPO-74-177) Avail: SOD HC $5.90

A national policy for aeronautical research and development is considered in view of increased foreign government subsidized competition. Factors discussed include: (1) government assistance in private enterprise efforts, without diminishing competition; (2) aeronautical technological capabilities, as compared to foreign competitors; (3) aeronautical research and development capabilities and facilities; (4) areas of possible government sponsored research and development; (5) implementation of aircraft noise control technology; (6) energy conservation in the form of reduced fuel consumption through design modification and weight reduction; (7) increased safety; and (8) airline industry economics (regulation vs deregulation). J.M.S.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N77-27067 Colorado Univ., Boulder.
A WIND TUNNEL INVESTIGATION OF THE FORMATION OF A TRAILING VORTEX Ph.D. Thesis
Michael Skok Francis 1976 223 p
Avail: Univ. Microfilms Order No. 77-3183

The incompressible flow field in the vicinity of a lifting rectangular finite wing is investigated experimentally to ascertain the nature and detailed characteristics of the formation and early development of a trailing vortex. The apparatus was designed and fabricated to facilitate a direct comparison of real flow data with existing theories and flow models. The mean velocity field was mapped directly using a linearized constant temperature hot wire anemometry probe in conjunction with a precision wind tunnel traversing mechanism. The associated vorticity field was inferred from these measurements through a spatial contour integration procedure. The existence of several identifiable 'flow regions' exhibiting similar characteristics was established and verified with both hot wire and flow visualization data. Among the regions examined extensively are the three dimensional wing boundary layer, the inboard potential flow region and the region of vortex shedding and roll up adjacent to the wing tip.
Dissert. Abstr.

N77-27068*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF EFFECTS OF UNSTEADY LIFT AND SPANWISE AVERAGING IN FLIGHT THROUGH TURBULENCE
William H. Phillips and Jacob H. Lichtenstein Jun. 1977 19 p refs
(NASA-TM-X-74028) Avail: NTIS HC A02/MF A01 CSCL 01A

Gust loads on aircraft flying through random atmospheric turbulence are attenuated at high frequencies by the effects of unsteady lift and spanwise averaging. Previously derived theoretical results for these two effects are placed in a form which makes direct comparison possible. The attenuation effects from each cause are found to be of approximately equal magnitude for unswept wings of moderate aspect ratio. For small values of the ratio of wingspan to scale of turbulence, the attenuation due to spanwise averaging is a function only of reduced frequency based on wingspan and is independent of the ratio of wingspan to scale of turbulence. Author

N77-27069*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FORTRAN PROGRAM FOR CALCULATING LEADING AND TRAILING-EDGE GEOMETRY OF TURBOMACHINE BLADES

Lawrence F. Schumann Jun. 1977 22 p refs
(NASA-TM-X-73679; E-9211) Avail: NTIS HC A02/MF A01 CSCL 01A

A FORTRAN IV program which calculates leading- and trailing-edge circle radii, tangency angles on the leading- and trailing-edge circles, and stagger angles of turbomachinery blade sections using only spline points defining the blade surfaces is described. The program shifts the origin of the blade coordinates to the leading edge of the blade. Required input includes (m, theta) coordinates of a sufficient number of spline points to adequately define the two surfaces of the blade. Other required input are the radii from the axis of rotation of the leading- and trailing-edges. The output from this program is used directly as the geometrical input for a NASA developed program for calculating transonic velocities on a blade-to-blade stream surface of a turbomachine. The program is used for axial, radial, and mixed flow turbomachine blades. Author

N77-27070*# Kanner (Leo) Associates, Redwood City, Calif.
FLOW EFFECTS WITH CROSS-BLOWN LIFTING JETS OF V/STOL AIRCRAFT AND THEIR REACTIONS ON AERODYNAMICAL FORCES AND MOMENTS OF THE AIRFRAME
Guenter Viehweger Washington NASA Jul. 1977 141 p refs Transl. into ENGLISH of "Stroemungsvorgaenge bei Angestroemeten Hubstrahlen von Kurz- und Senkrechtstartern und ihre Rueckwirkungen auf die Luftkraefter und Momente der Zelle", Rept. DLR-FB-76-34 DFVLR, Brunswick, 1976 113 p Original language document was announced as N77-17008
(Contract NASw-2790)
(NASA-TM-75143; DLR-FB-76-34) Avail: NTIS HC A07/MF A01 CSCL 01A

Systematic basic studies on the close and distant effects of cross blown single and twin lifting jets were performed with the aid of a principle model. The different effects are described in detail. The number of the experimental parameters is reduced to the most essential ones: (1) the angle of attack, (2) the flight and the jet velocities as well as the jet diameter, (3) the distance between the twin jets, (4) the location of the wing relative to the jets and the fuselage, and (5) the ground distance. The results of systematic pressure distribution measurements on the fuselage surface are studied, especially in the close vicinity of the jet exits. From these results, functions on the influence of the parameters are deduced. Author

N77-27071*# New York Univ., N. Y. ERDA Mathematics and Computing Lab.
NUMERICAL CALCULATION OF THE TRANSONIC FLOW PAST A SWEPT WING
Antony Jameson and D. A. Caughey (Cornell, Univ., N. Y.) Jun. 1977 97 p refs
(Grants NGR-33-016-167; NGR-33-016-201; Contract EY-76-C-02-3077)
(NASA-CR-153297; COO-3077-140) Avail: NTIS HC A05/MF A01 CSCL 01A

A numerical method is presented for analyzing the transonic potential flow past a lifting, swept wing. A finite difference approximation to the full potential equation is solved in a coordinate system which is nearly conformally mapped from the physical space in planes parallel to the symmetry plane, and reduces the wing surface to a portion of one boundary of the computational grid. A coordinate invariant, rotated difference scheme is used, and the difference equations are solved by relaxation. The method is capable of treating wings of arbitrary planform and dihedral, although approximations in treating the tips and vortex sheet make its accuracy suspect for wings of small aspect ratio. Comparisons of calculated results with experimental data are shown for examples of both conventional and supercritical transport wings. Agreement is good for both types, but it was found necessary to account for the displacement effect of the boundary layer for the supercritical wing, presumably because of its greater sensitivity to changes in effective geometry. Author

N77-27072*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUBSONIC LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A VECTORED-ENGINE-OVER-WING CONFIGURATION HAVING SPANWISE LEADING-EDGE VORTEX ENHANCEMENT
Jarrett K. Huffman and Charles H. Fox, Jr. May 1977 221 p refs
(NASA-TM-X-73955) Avail: NTIS HC A10/MF A01 CSCL 01A

A configuration which integrates a close coupled canard wing combination, spanwise blowing for enhancement of the wing leading edge vortex, an engine-over-wing concept, and a wing trailing edge coanda-effect flap is studied. The data on the configuration are presented in tabular from without discussion. The investigation was conducted in the Langley 7- by 10-foot high speed tunnel at a Mach number of 0.166 through an angle-of-attack range from -2 to 22 deg. Rectangular main engine nozzles of aspect ratio 4, 6, and 8 were tested over a momentum coefficient range from 1.0 to 1.8. Author

N77-27073*# Cincinnati Univ., Ohio.
INTERACTING TURBULENT BOUNDARY LAYER OVER A WAVY WALL
A. Polak and M. J. Werle [1977] 12 p refs
(Grant NsG-1208)
(NASA-CR-153394) Avail: NTIS HC A02/MF A01 CSCL 01A

The two dimensional supersonic flow of a thick turbulent boundary layer over a train of relatively small wave-like protuberances is considered. The flow conditions and the geometry are such that there exists a strong interaction between the viscous and inviscid flow. The problem cannot be solved without inclusion of interaction effects due to the occurrence of the separation singularity in classical boundary layer methods. The interacting boundary layer equations are solved numerically using a time-like relaxation method with turbulence effects represented by the inclusion of the eddy viscosity model. Results are presented for flow over a train of up to six waves for Mach numbers of 10 and 32 million/meter, and wall temperature rations (T sub w/T sub 0) of 0.4 and 0.8. Limited comparisons with independent experimental and analytical results are also given. Detailed results on the influence of small protuberances on surface heating by boundary layers are presented. Author

N77-27074*# Illinois Univ., Urbana. Aeronautical and Astronautical Engineering Dept.
LOW SPEED AIRFOIL STUDY Final Report
Allen I. Ormsbee 1 Jul. 1977 4 p refs
(Grant NGR-14-005-144)
(NASA-CR-153914; UILU-ENG-77-0511; AAE-77-11) Avail: NTIS HC A02/MF A01 CSCL 01A

Airfoil geometries were developed for low speed high lift applications, such as general aviation aircraft, propellers and helicopter rotors. The primary effort was to determine the extent to which the application of turbulent boundary layer separation criteria, plus manipulation of other input parameters, specifically trailing edging velocity ratio, could be utilized to achieve high C sub Lmax airfoils with relatively low drag at C sub Lmax. Both single-element and double-element airfoils were considered. Wind tunnel testing of some airfoils was included. Author

N77-27075*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SLENDER BODY TREATMENT OF SOME SPECIALIZED PROBLEMS ASSOCIATED WITH ELLIPTIC-CROSS-SECTION MISSILE CONFIGURATIONS
Raymond L. Barger Jul. 1977 21 p refs
(NASA-TN-D-8495; L-11425) Avail: NTIS HC A02/MF A01 CSCL 01A

Slender body methods were applied to some specialized problems associated with missile configurations with elliptic cross sections. Expressions are derived for computing the velocity distribution on the nose section when the ellipse eccentricity is varying longitudinally on the missile. The cross flow velocity on a triform fin section is also studied. Author

N77-27076*# Analytical Methods, Inc., Bellevue, Wash.
A THREE-DIMENSIONAL VISCOUS/POTENTIAL FLOW INTERACTION ANALYSIS METHOD FOR MULTI-ELEMENT WINGS
F. A. Dvorak, F. A. Woodward, and B. Maskew Jul. 1977 61 p refs

(Contract NAS2-8788)
(NASA-CR-152012; Rept-7603) Avail: NTIS HC A04/MF A01 CSCL 01A

An analysis method and computer program were developed for the calculation of the viscosity dependent aerodynamic characteristics of multi-element, finite wings in incompressible flow. A fully-three dimensional potential flow program is used to determine the inviscid pressure distribution about the configuration. The potential flow program uses surface source and vortex singularities to represent the inviscid flow. The method is capable of analysing configurations having at most one slat, a main element, and two slotted flaps. Configurations are limited to full span slats or flaps. The configuration wake is allowed to relax as a force free wake, although roll up is not allowed at this time. Once the inviscid pressure distribution is calculated, a series of boundary layer computations are made along streamwise strips. Author

N77-27077# Massachusetts Inst. of Tech., Cambridge.
WAKE MEASUREMENTS BEHIND A MAGNETICALLY-SUSPENDED SPINNING AND NON-SPINNING OGIVE CYLINDER AT ANGLES OF ATTACK Final Report
Douglas M. Finn, Charles W. Haldeman, and Eugene E. Covert Feb. 1977 77 p refs
(Contract DAAD05-74-C-0735)
(AD-A037836; TR-195; BRL-CR-331) Avail: NTIS HC A05/MF A01 CSCL 20/4

Total pressure measurements were performed in the wake of a magnetically-suspended ogive nosed cylinder immersed in a subsonic flow. Profile drag was computed by the momentum defect method and compared to magnetic balance measurements. Impact pressure wake profiles were then recorded to investigate the effects of varying Reynolds number, angle of attack, spin rate, and transition wake characteristics. Fully turbulent boundary layer conditions served to attenuate this reverse Magnus force and promote a linear relationship between the induced sidewash angle and spin rate. Interpretation of the pressure surveys enabled a qualitative assessment of flow conditions about the body to be made, leading to suggestions as to a possible source of the observed phenomena. GRA

N77-27078# New York Univ., Westbury. Aerospace and Energetics Lab.
INVESTIGATION OF NOZZLE EXTERNAL FLOW Final Report, 15 May 1974 - 31 Oct. 1975
Sergio Panunzlo, Anthony Agnone, and Edward Tory Sep. 1976 88 p refs
(Contract F33615-74-C-3071)
(AD-A037740; AFFDL-TR-76-99) Avail: NTIS HC A05/MF A01 CSCL 20/4

The results of an experimental investigation of the transonic flow over a turbojet boat-tail including the effects of the nozzle exhaust flow are presented. A new type of transonic facility with controllable infection and porosity at the tunnel wall was developed. It was used in the present investigation to simulate accurately both the inviscid and viscous flow fields so as to best represent the complex interaction prevalent at these conditions. The operation and performance of the facility is described here. The AGARD 15 deg boat-tail nozzle was used in the present body since the flow field over this nacelle has been reported extensively by several investigators. Therefore it established a reference configuration that serves to check proper facility operation and for comparison of the results. The present tests were conducted at a Mach number of approximately .90 in a test section of 23.25 inch (59.0 cm) diameter. Detailed measurements of the static pressure distribution on the boat-tail in the facility indicate a significant upstream movement of the separation point and shock with small to moderate changes in the nozzle pressure ratio while increases in the Reynolds number cause a downstream movement of the separation point and of the shock wave. GRA

N77-27079# General Dynamics/Convair, San Diego, Calif.
COMPUTATIONAL RESEARCH ON INVISCID, UNSTEADY TRANSONIC FLOW OVER AIRFOILS Final Report
R. J. Magnus Jan. 1977 76 p refs
(Contract N00014-73-C-0294)
(AD-A037469; CASD/LVP-77-010) Avail: NTIS HC A05/MF A01 CSCL 20/4

The inviscid transonic flow over an NACA 64A410 airfoil oscillating in pitch in a Mach 0.72 stream was calculated with a program based on the unsteady Euler equations. The airfoil oscillates about a mid-chord axis. The effects of two approximations made in the analysis, handling boundary conditions at the airfoil surface and at the perimeter of the computation field, were studied. Author (GRA)

N77-27080# Toronto Univ. (Ontario).
AN INVESTIGATION OF THE EFFECT OF BALLONET MOTIONS ON TETHERED-AEROSTAT LONGITUDINAL DYNAMIC STABILITY
James DeLaurier May 1977 27 p refs
(UTIAS-TN-205; CN-ISSN-0082-5263) Avail: NTIS HC A03/MF A01

The frozen ballonet assumption was re-examined analytically. Longitudinal stability equations were extended to include the internal air and gas motions, and then applied to a specific Family II aerostat in order to show effect of ballonet constraint and damping on its longitudinal stability. B.B.

N77-27081# General Applied Science Labs., Inc., Westbury, N.Y.
THE EFFECTS OF VISCOUS INTERACTION ON THE TRANSONIC JET-FLAP Final Report, 1 Oct. 1975 - 30 Sep. 1976
P. Baronti, S. Elzweig, and G. Miller Mar. 1977 45 p refs
(Contract F44620-76-C-0017)
(AD-A038625; GASL-TR-237; AFOSR-77-0446TR) Avail: NTIS HC A03/MF A01 CSCL 01/3

The inviscid and viscous effects associated with a jet-flapped airfoil in the transonic regime are investigated. The particular formulation developed employs integral methods for the description of the viscous portions of the flow utilizing the turbulent kinetic energy equation and a relaxation method for the inviscid portions. The viscous-inviscid coupling procedures along the wing and the jet acknowledge the importance and magnitude of the viscous effects on pressure distribution and directly incorporate the displacement effect on the wing and the effects of the jet mixing into the boundary conditions for the computation of the entire flow. Some numerical results are presented to validate the solution techniques that have been selected and to assess the importance of mass and momentum entrainment into the jet on jet flap effectiveness. Author (GRA)

N77-27082# Payne, Inc., Annapolis, Md.
RESEARCH ON PARACHUTE OPENING Final Scientific Report, 15 Sep. 1975 - 30 Oct. 1976
Peter R. Payne and E. G. U. Band Nov. 1976 24 p refs
(Contract F44620-76-C-0020)
(AD-A038193; Working-Paper-145-13; AFOSR-77-0317TR) Avail: NTIS HC A02/MF A01 CSCL 01/3

This report summarizes work carried out in connection with parachute opening theory. Contributions were made in the following areas: (a) prediction of fabric porosity effects; (b) calculation of the external and internal pressure fields during inflation; and (c) calculation of the canopy shape and stress distribution during inflation. These three elements, taken together, cover the problem, but they were not integrated into a complete predictive methodology because of lack of time. GRA

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N77-27083*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL AND LATERAL-DIRECTIONAL STATIC AERODYNAMIC CHARACTERISTICS OF AN UNPOWERED ESCAPE SYSTEM EXTRACTION ROCKET MODEL WITH

ATTACHED LAUNCH TUBES
Jarrett K. Huffman, Charles H. Fox, Jr., and Robert E. Satterthwaite May 1977 26 p refs
(NASA-TM-X-74012) Avail: NTIS HC A03/MF A01 CSCL 01C

An escape system extraction rocket proposed for use on the Rotor Systems Research Aircraft was tested at Mach numbers of 0.1 and 0.3 through an angle of attack range from -2 deg to 102 deg and an angle of sideslip range from 0 deg to 15 deg in the Langley 7- by 10-foot high speed tunnel. The data are presented without analysis. Author

N77-27084*# Scientific Translation Service, Santa Barbara, Calif.
QUESTIONNAIRE SURVEY REPORT ON INSTRUMENT CHECK AT TAKE-OFF
Washington NASA May 1977 28 p Transl. into ENGLISH of the book "Ririkuji no Keiki Tenken ni Tsuite Anketto Chosa Hokoku", Tokyo, 1 Jul. 1975 p 1-26
(Contract NASw-2791)
(NASA-TT-F-17531) Avail: NTIS HC A03/MF A01 CSCL 01C

A survey was conducted from September to November 1974 questioning captains, copilots, flight engineers, and second officers of Japan Air Lines. Data actually observed at takeoff were analyzed. Author

N77-27085# National Aviation Facilities Experimental Center, Atlantic City, N. J.
EVALUATION OF A HALON 1301 SYSTEM FOR AIRCRAFT INTERNAL PROTECTION FROM A POSTCRASH EXTERNAL FUEL FIRE Final Report, Sep. 1975 - Mar. 1976
Richard Hill Mar. 1977 28 p refs
(AD-A039058; FAA-NA-76-42; FAA-RD-76-218) Avail: NTIS HC A03/MF A01 CSCL 01/2

The use of a Halon 1301 fire suppression system was evaluated in regard to increasing occupant escape time during a ground crash situation with an external fire adjacent to a cabin opening. Tests were conducted in a DC7 fuselage, varying the exit configurations and external wind conditions. Tests were also conducted using a curtain to compartmentize the cabin, with the Halon 1301 concentration and location of discharge being varied. Smoke, temperature, carbon monoxide, oxygen, and Halon 1301 levels were continuously monitored during the tests at various locations throughout the cabin. Hydrogen fluoride (HF) and hydrogen bromide (HBr) concentrations were obtained by analyzing samples taken from the cabin at various times. The results indicated that the length of protection from flame penetration through an opening was dependent upon external wind conditions. Flame penetration was controlled for up to 3.5 minutes with zero wind, but with a wind of as little as 2 miles per hour (mi/h), the time was reduced to less than 15 seconds. HF levels were rapidly reached inside the cabin, with concentrations ranging from 60 parts per million (p/m), with no wind, to well over 300 p/m with 2-mi/h wind conditions. Author

N77-27086# Select Committee on Small Business (U. S. Senate).
THE DECLINE OF SUPPLEMENTAL AIR CARRIERS IN THE UNITED STATES, PART 1
Washington GPO 1976 404 p refs Hearings before Subcomm. on Monopoly of the Select Comm. on Small Business, 94th Congr., 2d Sess., 6-8 Oct. 1976
(GPO-78-955) Avail: Subcomm. on Monopoly

Testimony on airline deregulation is given in detail as a means to introduce competition into the air transportation industry. Evidence was presented supporting the necessity for carriers operating large aircraft to routinize their operations. B.B.

N77-27087*# Duke Univ., Durham, N.C. Dept. of Civil Engineering.
THE POTENTIAL FOR HELICOPTER PASSENGER SERVICE IN MAJOR URBAN AREAS
Jarir S. Dajani, Ralph G. Stortstrom, and Dennis B. Warner Mar. 1977 94 p refs
(Grant NsG-1121)
(NASA-CR-145224) Avail: NTIS HC A05/MF A01 CSCL 05C

An interurban helicopter cost model having the capability of selecting an efficient helicopter network for a given city in terms of service and total operating costs was developed. This model which is based upon the relationship between total and direct operating costs and the number of block hours of helicopter operation is compiled in terms of a computer program which simulates the operation of an intracity helicopter fleet over a given network. When applied to specific urban areas, the model produces results in terms of a break-even air passenger market penetration rate, which is the percent of the air travelers in each of those areas that must patronize the helicopter network to make it break even commercially. A total of twenty major metropolitan areas are analyzed and are ranked initially according to cost per seat mile and then according to break-even penetration rate. Author

N77-27088# Federal Aviation Administration, Washington, D. C. Information and Statistics Div.
CURRENT AVIATION STATISTICS, AIR TRAFFIC ACTIVITY. TERMINAL AREA RELATIONSHIPS. FISCAL YEAR 1976
George E. Thompson Mar. 1977 59 p
(AD-A038847) Avail: NTIS HC A04/MF A01 CSCL 01/2

The current study of terminal area airport operations encompasses FY 1976 data for 415 airports at which FAA traffic control towers operated the entire twelve months period. These are presented in two primary groups: Air Commerce Airports, and General Aviation Airports. Each tower is requested to report the peak daily traffic count during the previous twelve months for air carrier, itinerant (including air carrier), total aircraft (including local) and instrument operations. Peak counts for the various categories need not occur on the same day. These peak days can be accurately identified from the daily traffic counts recorded on FAA Form 7230-1. Busy hour estimates are obtained from periodic counts 60 minutes in duration. These counts are made during known high activity periods of each traffic category. From this sample, tower personnel select a count which is representative of daily busy hour activity for each category. The tables contain traffic estimates for each airport at which an air traffic control tower operated during all of FY 1976. Provided with peak day and busy hour are average day and hour operations computed from annual operations. Measures of peaking characteristics are given by the ratios of peak day to average day and busy hour to average hour for individual airports and airport size groups. Author (GRA)

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications*.

N77-27089# Systems Control, Inc., Palo Alto, Calif.
ALASKAN AIR NAVIGATION REQUIREMENTS. VOLUME 2, PART 1: NEAR TERM BENEFIT ANALYSIS OF THE ALASKAN AIR NAVIGATION SYSTEM Final Report
H. L. Solomon, W. Heine, A. R. Stephenson, and E. McConkey Jan. 1977 79 p
(ARD-330-01-77-Vol-2-Pt-1; AD-A038662; FAA-RD-76-27-Vol-2-Pt-1) Avail: NTIS HC A05/MF A01 CSCL 17/7

An analysis of the problems and near term solutions related to Alaska's air navigation system is presented. The needs of the air taxi operators and major intrastate scheduled air carriers are considered based on such figures of merit as enroute navigation gaps, traffic volume, landing probabilities and candidate navigation system characteristics. It is concluded that 6 VOR/DME's and 6 NDB/DME's would be adequate to satisfy most of Alaska's near term enroute and terminal air navigation requirements, respectively. Recommended implementation sequences are provided for each combination of candidate NAVAID (NDB,

NDB/DME, VOR, VOR/DME and TACAN) and application (enroute, approach and dual enroute/approach). Author

N77-27090# Systems Control, Inc., Palo Alto, Calif.
ALASKAN AIR NAVIGATION REQUIREMENTS. VOLUME 2, PART 2: APPENDICES Final Report
H. L. Solomon, W. Heine, A. R. Stephenson, and E. McConkey Jan. 1977 272 p
(AD-A038637; FAA-RD-76-27-Vol-2-Pt-2; ARD-330-01-77-Vol-2-Pt-2) Avail: NTIS HC A12/MF A01 CSCL 17/7

Appendices are presented of detailed supplemental information addressing some of the following: (1) potential user benefits, (2) updated FAA Alaskan Region recommendations for VORTAC installations, (3) safe and scheduled departure statistics, (4) characteristics of Alaskan airports, (5) ceiling and visibility minimums as a function of type of approach aid, and (6) a statistical summary of avionics equipment installed on Alaska based aircraft. B.B.

N77-27091# IIT Research Inst., Annapolis, Md.
ALASKAN AIR NAVIGATION REQUIREMENTS. VOLUME 3: FAA ALASKAN VHF OMNIDIRECTIONAL RANGE (VOR) SITE COVERAGE Final Report
Robert L. Harlem and Henry Bernstein Jan. 1977 21 p
(Contracts DOT-FA70WAI-175; F19628-76-C-0017)
(AD-A038663; ECAC-PR-75-077-Vol-3; FAA-RD-76-27-Vol-3) Avail: NTIS HC A02/MF A01 CSCL 17/7

Map overlays were developed for 30 existing and 28 proposed VOR sites in Alaska for the Federal Aviation Administration. The overlays were to be utilized to determine the VOR coverage provided by these sites in Alaska. A new terrain data extraction technique called the Chromatic Extraction Technique, was developed for this task and is described. Author

N77-27092# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE ATCRBS MODE OF DABS
J. L. Gertz 31 Jan. 1977 240 p
(Contracts DOT-FA72WAI-261; F19628-76-C-0002)
(AD-A038543; ATC-65; FAA-RD-76-39) Avail: NTIS HC A11/MF A01 CSCL 17/7

An overview of all the functions performed by the air traffic control radar beacon system is presented. The algorithms designed to perform these functions are described in detail. For each algorithm the rationale as well as the purpose is reviewed. Other topics discussed are some of the following: (1) functions performed by the reply processor hardware, (2) software functions, (3) reply correlation and raw target formation procedures, (4) correlation of discrete code target reports and tracks, and (5) identification and processing of various classes of false alarm target reports. B.B.

N77-27093# National Aviation Facilities Experimental Center, Atlantic City, N. J.
AREA NAVIGATION/VERTICAL AREA NAVIGATION TERMINAL SIMULATION Final Report, Aug. - Nov. 1975
William Crimbring and John Maurer Mar. 1977 129 p refs
(AD-A038623; FAA-NA-76-28; FAA-RD-76-211) Avail: NTIS HC A07/MF A01 CSCL 17/7

A dynamic simulation using the digital simulation facility, was conducted to determine the effects on the air traffic control (ATC) system and the system users. The information was derived from the use of area navigation (RNAV) and area navigation with vertical guidance (VNAV) in a high density terminal area. The John F. Kennedy Airport airspace was configured with an RNAV/VNAV route system to provide the test bed. Selected controller workload and system performance measures for various mixtures of RNAV, VNAV, and radar vectored operations were analyzed. Results show that controllers can use RNAV/VNAV maneuvers in the control of traffic in lieu of radar vector techniques and that controller workload decreased as the level of RNAV/VNAV participation increased. Controller acceptance of RNAV/VNAV principles and techniques in the ATC terminal area increased as familiarity and experience with RNAV/VNAV were gained. Controllers favored the use of RNAV over a pure radar vector environment. Significant decreases in controller communications workload and slight increases in operations were recorded as the percentages of RNAV/VNAV aircraft in the system were increased. Author

N77-27094# Federal Aviation Administration, Washington, D. C.
IMPACT OF AUTOMATION UPON AIR TRAFFIC CONTROL SYSTEM PRODUCTIVITY/CAPACITY (ARTS III) Final Report
William T. Kuhar, Paul Gavel, and James A. Moreland Nov. 1976 39 p
(AD-A038659; FAA-RD-77-39) Avail: NTIS HC A03/MF A01 CSCL 17/7

The results of a study to assess the impact of the Automated Radar Terminal System (ARTS III) upon air traffic control system capacity are presented. Measurements were taken of both the pre-ARTS III and post-ARTS III environments and comparisons were made to determine the direction and degree of change attributable to ARTS III. The results indicate that the ARTS III system has reduced controller workload and increased system capacity by 10.5%. A reasonable estimate of the productivity increase is 8.5%. Author

N77-27095# National Aviation Facilities Experimental Center, Atlantic City, N. J.
STUDY OF NAVAIDS REMOTE PERFORMANCE CONTROL AND DISPLAY. PROTOTYPE DESIGN AND OPERATIONAL CHARACTERISTICS FOR DATA LOGGING, DISPLAY AND CONTROL OF A NAFEC TEST MODEL (ILS, VOR, TACAN) Final Report
Morris Ritter, Jack Bernstein, Ronald Polillo, Carmen Munafo, James L. Dottavi, and Matthew Naimo May 1977 55 p
(AD-A039781; FAA-NA-77-30) Avail: NTIS HC A04/MF A01 CSCL 17/7

A standardized and modularized approach for the remoting of certification type data for multiple NAVAIDS (VOR, TACAN, ILS, etc.) to provide ATF status and control at a central location is presented. Growth potential to encompass other NAVAID types (RCAG, ALS, RVR, Beacon/Radar, etc.) can be incorporated in the proposed system, providing the proper interfaces are accomplished. Author

N77-27096# Systems Control, Inc., Palo Alto, Calif.
IMPLEMENTATION OF AREA NAVIGATION IN THE NATIONAL AIRSPACE SYSTEM: AN ASSESSMENT OF RNAV TASK FORCE CONCEPTS AND PAYOFFS Final Report
W. H. Clark, E. H. Bolz, H. L. Solomon, and A. R. Stephenson Dec. 1976 496 p refs
(Contract DOT-FA72WA-3098)
(AD-A039225; FAA-RD-76-196) Avail: NTIS HC A21/MF A01 CSCL 17/7

The cost, operational impact, and economic benefits which are expected to accrue to the ATC system and various users of the National Airspace System as a result of the implementation of the Area Navigation were assessed. Previous impact analyses are expanded to include the primary aspects of ATC system operation and to include a broad spectrum of user groups, route structures, and types of operation. System impact results are presented pertaining to slant range effects, VORTAC requirements, ATC automation, airspace capacity, route development, charting, flight inspection, VNAV, controller training, and controller productivity. User impact results are presented in terms of fuel and time increment benefits for several classes of users, comparing 2D RNAV to VOR in the high and low altitude structures, and comparing 2D, 3D and 4D TRNAV to VOR/radar vectors in the terminal area. Estimates are made of total annual savings due to RNAV, and an analysis of user equipment cost versus benefits is presented. Author

N77-27097# Lockheed-California Co., Burbank.
THE ROLE OF SIMULATION METHODS IN THE AIRCRAFT CERTIFICATION PROCESS Final Report
Don M. Archibald Mar. 1977 86 p refs
(Contract DOT-FA76WA-3856)
(AD-A039637; FAA-RD-77-17) Avail: NTIS HC A05/MF A01 CSCL 17/7

The extent to which the use of simulation may be increased during aircraft certification in the future was assessed

by surveying recent industry experience and obtaining recommendations relative to the objectives of Advisory Circular 21-14. In addition to the industry assessment, a review of FAR-25 requirements from the economic and technical standpoint was made. Additional simulation in the certification process appears to be both economically attractive and technically feasible, particularly in the area of aircraft systems. The performance demonstrations, currently accomplished by flight testing, is an additional area where simulation may be applied. Author

N77-27098# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AIR-TO-AIR VISUAL ACQUISITION PERFORMANCE WITH PILOT WARNING INSTRUMENTS (PWI)
J. W. Andrews 25 Apr. 1977 65 p refs
(Contracts DOT-FA72WAI-261; F19628-76-C-0002)
(AD-A039714; ATC-73; FAA-RD-77-30) Avail: NTIS HC A04/MF A01 CSCL 01/4

Major issues in the design of pilot warning instruments are reviewed. Visual acquisition performance is described in terms of a nonhomogeneous Poisson process. It is shown that the major test results can be explained in terms of an acquisition rate which is proportional to the solid angle subtended by the target. Model parameters are derived by maximum likelihood techniques. A statistical analysis of significance is performed. Performance predictions for a wide variety of aircraft sizes, approach speeds, and visibility conditions are presented. Author

N77-27099# Federal Aviation Administration, Washington, D. C.
CENTRAL FLOW CONTROL AUTOMATION PROGRAM COST-BENEFIT ANALYSIS Final Report
Carlo J. Broglio and Thomas C. Hannan Sep. 1976 54 p refs
(AD-A040060; FAA-RD-77-53) Avail: NTIS HC A04/MF A01 CSCL 17/7

An analysis of the benefits and costs associated with the central flow control automation program is presented. The projected benefits and costs of both the current system and proposed system in terms of present-value dollars are reviewed. Resultant benefit and cost differentials are discussed in terms of net present value and benefit-to-cost ratio. The sensitivity of these measures to major program uncertainty is described. Author

N77-27100# Missouri Univ., Rolla. Dept. of Electrical Engineering.
EVALUATION OF RANGE-LIMITED HORIZON CORRELATION BY USING PSEUDO-TERRAIN Technical Report, 1 Mar. 1976 - 28 Feb. 1977
Gordon E. Carlson, George L. Bair, Paul W. Sapp, and David M. Simmons Mar. 1977 176 p refs
(Contract N00014-75-C-0639; NR Proj. 387-076)
(AD-A038339; CSR-77-2) Avail: NTIS HC A09/MF A01 CSCL 17/7

The development of pseudo-terrain with statistics which are similar to actual terrain and its application to the analysis of the range-limited horizon comparison system for airborne vehicle position determination is presented. Pseudo-terrain was used to aid in characterizing system performance as a function of terrain roughness. Additional system analyses presented include analyses of system performance effects of changing the horizon range limit or the sensed horizon spacing. Also shown are results of an analysis of system performance for higher vehicle altitudes (up to 10Km). A brief analysis of the position accuracy improvement which can be achieved by using along-track and cross-track interpolation of the horizon comparison function is shown. Author (GRA)

N77-27101# Naval Surface Weapons Center, Dahlgren, Va.
BEACON TRACKING SYSTEMS SIMULATION
Elodie S. Colquitt Mar. 1977 56 p
(AD-A038643; NSWC/DL-TR-3514) Avail: NTIS HC A04/MF A01 CSCL 17/3

The Beacon Tracking System is designed to determine the position of a beacon transmitter carried aboard a surface or air target using the Time-Difference-of-Arrival (TDOA) concept. Target position is computed based on a weighted least-squares solution of the TDOA data. A computer simulation of the system is used to investigate the systems sensitivity to several parameters. Sensitive parameters are shown to be: (1) receiver geometry relative to the target; (2) receiver position survey accuracy; and (3) loss of signal by one or more receivers during a track. Author (GRA)

N77-27102# Facility Checking Squadron (1866th) (AFCS), Richards-Gebaur AFB, Mo.
TRACALS EVALUATION REPORT. ILS STATION EVALUATION REPORT, LUKE AFB, AZ 1 - 13 DECEMBER 1976 Final Report
Kathryn Y. Barnhart 4 Apr. 1977 85 p
(AD-A038390; Rept-76/66N-84) Avail: NTIS HC A05/MF A01 CSCL 01/2

This evaluation report presents data collected and analyzed to define the capabilities and limitations of the Luke AFB ILS AN/MRN-7/8 A and its associated power system. The ground evaluation phase was conducted 1-9 Dec 1976, and flight evaluation was conducted from 10-13 Dec. Detailed results of the ground equipment checks and the airborne evaluation are included. These results indicate that the facility is fully capable of providing satisfactory service. The data presented in this report can be used as a valid guide to anticipated performance until there is a significant change in the ground equipment, the horizon screening, or terrain. Author (GRA)

N77-27103# Air Force Weapons Lab., Kirtland AFB, N.Mex.
COMPUTER-PROGRAM FOR FAA/ATCRBS TAPE READER, PROGRAM JASPER 1 Final Report, Oct. 1974 - 1 May 1976
Mead Wetherbe and William J. Moulds Mar. 1977 72 p
(AD-A038875; AFWL-TR-76-219) Avail: NTIS HC A04/MF A01 CSCL 17/7

This report presents an AFWL modified computer code, JASPER, which combines two computer codes originally developed by MIT Lincoln Laboratories. JASPER automatically identifies reflecting surfaces which cause false targets in the Air Traffic Control Radar Beacon System ATCRBS, and determines their positions and orientation. The code is presently capable of processing data extracted from ARTS-3 terminal area processing systems. An explanation of the code is provided and a sample problem is included so that the user may become familar with the input data and the flexibility of the output list. A later version of JASPER IN close to ANSI FORTRAN has been written. This version can be easily adapted to use on most computers. Data unpacking is done without the use of shift or masking expressions. JASPER is written in FORTRAN version 3.4.4 scope for the CDC 7600 computer. Author (GRA)

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*

N77-27104*# Boeing Vertol Co., Philadelphia, Pa.
IDENTIFYING AND ANALYZING METHODS FOR REDUCING THE ENERGY CONSUMPTION OF HELICOPTERS
S. Jon Davis and Harold J. Rosenstein Dec. 1976 22 p
(Contract NAS1-13624)
(NASA-CR-144953A) Avail: NTIS HC A02/MF A01 CSCL 01C

Reductions in helicopter energy consumption can be accomplished through the use of advanced technology in the areas of powerplant design, improved rotor efficiency, reduced parasite drag, and reduced structural empty weight. Baseline helicopters incorporating technology were designed for a short range (200 n mi) and a very short haul (100 n mi) mission scenario. Parametric analyses were then conducted to determine the impact of technology improvement. Many of the parameters varied are interrelated. A summary of such interactions is presented, and some additional sensitivity values were added so that energy reduction and DOC as affected by the major technological factors or operational modes are clearly defined. Author

N77-27105*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CALCULATED DYNAMIC CHARACTERISTICS OF A SOFT-INPLANE HINGELESS ROTOR HELICOPTER

Wayne Johnson Jun. 1977 29 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.

(NASA-TM-73262; A-7115) Avail: NTIS HC A03/MF A01 CSCL 01C

Calculated dynamic characteristics of a representative soft-inplane hingeless rotor helicopter are presented. The flight dynamics as a function of speed and gross weight are given. The requirements for accurate analytical modelling of this helicopter are established. The influence of the horizontal tail size, the rotor precone, the blade sweep, and the blade center of gravity/aerodynamic center offset on the calculated flight dynamics and aeroelastic stability are examined. The calculations show no evidence of an air resonance stability problem with this aircraft. Author

N77-27106*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PASS: A COMPUTER PROGRAM FOR PRELIMINARY AIRCRAFT STRUCTURAL SYNTHESIS

Erwin H. Johnson Jun. 1977 44 p refs

(NASA-TM-73216; A-6954) Avail: NTIS HC A03/MF A01 CSCL 01C

A computer code for Preliminary Aircraft Structural Synthesis provides rapid and accurate analysis for aircraft structures that can be adequately modeled by beam finite elements. The philosophy used in developing the program was to provide a basic framework that can be used for structural synthesis. It is anticipated that a user will need to add detail to this framework in order to perform his specific task. With this philosophy in mind, the program was written so that it is easily divided into segments, thereby making it readily adaptable. The theoretical portion of this manual describes the basic structure of the program and details the development of the unique beam element that is used. The present capability of the algorithm is stated and suggestions are made regarding enhancements to this capability. User information is also given that provides an overview of the program's construction, identifies the required inputs, describes the program output, provides some comments on the program use, and exhibits results for a simple example. Author

N77-27107*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

USE OF EXPERIMENTAL SEPARATION LIMITS IN THE THEORETICAL DESIGN OF V/STOL INLETS

Michael A. Boles (Indiana Inst. of Technology) and Norbert O. Stockman Jul. 1977 24 p refs Presented at the 13th Propulsion Conf., Orlando, Fla., 11-13 Jul. 1977; sponsored by AIAA and SAE

(NASA-TM-73709) Avail: NTIS HC A02/MF A01 CSCL 01C

Experimental data from several model inlets are used to generate two parameters which are related to the limit of operation for inlet flow separation. One parameter, called the diffusion ratio, is the ratio of the peak velocity on the inlet surface to the velocity at the diffuser exit and is related to the boundary-layer separation at low throat Mach numbers. The other parameter, the peak Mach number on the inlet surface, is related to the separation at high throat Mach numbers. These parameters are easily calculated from potential flow solutions and thus can be used as a design tool in screening proposed inlet geometries. An illustrative example of an application to an inlet design study for a tilt nacelle VTOL airplane is presented. The value of contraction ratio required to meet the operating requirements yet allow the inlet to remain free of separation as indicated by the two separation parameters is shown. Author

N77-27108*# Illinois Univ., Urbana. Aeronautical and Astronautical Engineering Dept.

DESIGN OF HIGH LIFT AIRFOILS WITH A STRATFORD DISTRIBUTION BY THE EPPLER METHOD

William G. Thomson Jun. 1975 86 p refs

(Grant NGR-14-005-144)

(NASA-CR-153913; UILU-ENG-75-0505; AAE-75-5) Avail: NTIS HC A05/MF A01 CSCL 01A

Airfoils having a Stratford pressure distribution, which has zero skin friction in the pressure recovery area, were investigated in an effort to develop high lift airfoils. The Eppler program, an inverse conformal mapping technique where the x and y coordinates of the airfoil are developed from a given velocity distribution, was used. J.M.S.

N77-27109# ARO, Inc., Arnold Air Force Station, Tenn.

STATIC STABILITY AND DRAG EFFECTS OF VARIOUS EXTERNAL STORE CONFIGURATIONS ON THE F-15 AIRCRAFT AT MACH NUMBERS FROM 0.6 TO 1.3 Final Report

James M. Whoric Eglin AFB, Fla. AFATL Apr. 1977 85 p ref

(AD-A038494; ARO-PWT-TR-76-14; AEDC-TR-76-73; AFATL-TR-76-54) Avail: NTIS HC A05/MF A01 CSCL 01/3

The results of transonic wind tunnel tests in which the effects of external stores on the aerodynamic characteristics of the F-15 aircraft were determined are presented and discussed. The analysis includes evaluations of the incremental drag rise, the incremental changes in static margin, and the lateral directional derivatives associated with the various store configurations. Wind tunnel coefficient data for several baseline configurations are also presented. Data are presented for Mach numbers ranging from 0.6 to 1.3 at angles of attack from -4 to 20 deg at zero-deg sideslip angle, and for sideslip angles from -4 to 10 deg at angles of attack of 0, 10, 15, and 20 deg. GRA

N77-27110# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Vehicle Equipment Div.

AN EXPERIMENTAL INVESTIGATION OF TRUNK FLUTTER OF AN AIR CUSHION LANDING SYSTEM Final Report, Jun. 1974 - Mar. 1975

Carmine J. Forzono Nov. 1976 100 p refs

(AD-A038559; AFFDL-TR-75-107) Avail: NTIS HC A05/MF A01 CSCL 01/3

The objective of this work was to experimentally investigate the phenomenon of air cushion vehicle trunk flutter and attempt to eliminate it. The occurrence of trunk flutter was found to be eliminated with the use of tread strips, 1/2 in.-wide pieces of rubber, cut to certain lengths and thickness attached to the bottom of the trunk tread. These strips form channels when placed side-by-side that allow the flutter-producing cushion air to escape from beneath the vehicle without causing trunk flutter. This flutter elimination device can be employed without the loss of the required cushion pressure or an increase of the drive air flow into the air cushion system. It is recommended that a dynamic air cushion system that is known to exhibit flutter, be designed with a trunk tread having permanently affixed tread strips. These tests are needed to confirm the successful flutter eliminating characteristics of tread strips, which are statically tested in this report. Author (GRA)

N77-27111# General Dynamics/Convair, San Diego, Calif.

SELF OPTIMIZING FLEXIBLE TECHNOLOGY WING PROGRAM, SEMISPAN WIND TUNNEL TEST OF A GENERALIZED GEOMETRY WING PANEL. MODEL DESIGN AND AERODYNAMIC ANALYSIS Interim Technical Report, 15 Apr. 1976 - 14 Feb. 1977

Ely S. Levinsky, R. H. Schappelle, and A. A. McClain 14 Feb. 1977 121 p refs

(Contract N00014-76-C-0742)

(AD-A039085; CASD-NSC-77-001; ONR-CR212-224-3) Avail: NTIS HC A06/MF A01 CSCL 01/3

Various aspects of the design and stress, flutter, aerodynamic and computer analyses are presented for a 1/6th scale semispan Self-Optimizing Flexible Technology soft Wing Wind Tunnel Model representative of the AFTI-111 configuration, to be tested at AEDC tunnel 16 T. The model features twelve independent hydraulic actuator systems which are designed to conformally vary leading edge radius, leading edge deflection about the 15% and 25% chord lines, upper surface humping, and trailing edge deflection about the 65% and 80% chord lines at an inboard and outboard station. The model is designed to be tested interactively under computer control in such a manner so as to optimize any one of eighteen possible aerodynamic or structural functions, while satisfying equality or inequality constraints with the remaining seventeen. These functions are to be measured

on line by either the wind tunnel balance, potentiometers, wing pressure orifices or strain gages. Simulations of the wing optimization procedure are presented using a highly simplified set of nonlinear algebraic equations to generate the aerodynamic functions. The simulations show that convergence may be obtained for various optimization problems, even when randomly generated testing type errors are included, provided however, that the various parameters in the optimization computer program have been properly tuned for the particular optimization problem. Author (GRA)

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N77-27112# Air Force Avionics Lab., Wright-Patterson AFB, Ohio.

REPORT ON HIGH-ORDER LANGUAGE (HOL) STANDARDIZATION FOR AVIONICS Final Report, Aug. - Sep. 1976

W. Lynn Trainor Jan. 1977 89 p refs

(AD-A038054; AFAL-TR-76-254) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report documents the results of a high-order programming language HOL standardization study for avionics systems. Existing HOL usage was surveyed as well as current status and trends of Air Force and DOD HOL standardization attempts. An in-depth comparison was made of the status of the two most prominently used HOL's in avionics, JOVIAL-73 and JOVIAL-3B. Trends in usage of HOL's and assembly language for avionics were discussed. Author (GRA)

N77-27113# Naval Postgraduate School, Monterey, Calif.

MICROCOMPUTER BASED SOLID STATE CRASH DATA RECORDER FOR MILITARY AIRCRAFT M.S. Thesis

William Ramon Albertolli Dec. 1976 96 p refs

(AD-A038778) Avail: NTIS HC A05/MF A01 CSCL 01/2

The design, breadboard implementation, and functional testing of a Crash Data Recorder for military aircraft is reported. A microcomputer is used to analyze the flight parameters, reduce redundant data, and record only significant information to be used in post-crash analysis. Nonvolatile solid state memory is used as the recording medium. Functional tests indicate that the solid state recorder's reliability is higher than that of mechanical magnetic tape recorders while cost, weight, size, and required maintenance are greatly reduced. The microcomputer provides an expansion capability for future applications of the flight recorder. Research and development, structural history, maintenance analysis, and training are areas where the Crash Data Recorder can also serve as an analytical tool. Continued research in this subject is highly recommended. Author (GRA)

N77-27114# Radio Corp. of America, Burlington, Mass. Automated Systems.

EXTENDED EXPLORATORY DEVELOPMENT - HOLOGRAPHIC HORIZONTAL DISPLAY Final Report, 14 Jan. - 19 Sep. 1976

G. T. Burton Nov. 1976 91 p

(Contract N62269-76-C-0134)

(AD-A038123; NADC-75194-30) Avail: NTIS HC A05/MF A01 CSCL 01/4

This is a final report describing the effort conducted under Contract N62269-76-C-0134. The program addressed two specific areas concerned with improvement of the performance characteristics and configuration of the Holographic Horizontal Situation Display (HHSD), system under development by RCA to satisfy the HSD requirement of the AID cockpit concept. The areas of concern were: (1) the definition and implementation of methods of improving the holographic recording process to allow the consistent production of holograms of improved color fidelity and brightness and; (2) the definition and implementation of methods of simplifying and improving the reliability of the retrieval system used to rapidly access and register the stored holograms. Author (GRA)

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N77-27115*+ Detroit Diesel Allison, Indianapolis, Ind.

PRELIMINARY DESIGN OF PROPULSION SYSTEM FOR V/STOL RESEARCH AND TECHNOLOGY AIRCRAFT Final Report

Mar. 1977 215 p

(Contract NAS3-20053)

(NASA-CR-135207; DDA-EDR-9082) Avail: NTIS HC A01 CSCL 21E

The V/STOL Research and Technology Aircraft (RTA) propulsion system design effort is limited to components of the lift/cruise engines, turboshaft engine modifications, lift fan assembly, and propulsion system performance generation. The uninstalled total net thrust with all engines and fans operating at intermediate power was 37,114 pounds. Uninstalled system total net thrust was 27,102 pounds when one lift/cruise is inoperative. Components have lives above the 500 hours of the RTA duty cycle. The L/C engine used in a fixed nacelle has the cross shaft forward of the reduction gear whereas the cross shaft is aft of the reduction gear in a tilt nacelle L/C engine. The lift/cruise gearbox contains components and technologies from other DDA engines. The rotor has a 62-inch diameter and contains 22 composite blades that have a hub/tip ratio of 0.454. The blade pitch change mechanism contains hydraulic and mechanical redundancy. The lift fan assembly is completely self-contained including oil cooling in 10 exit vanes. Author

N77-27116* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

BLADE RETAINER ASSEMBLY Patent

George W. Luebering, inventor (to NASA) (GE, Cincinnati) Issued 5 Jul. 1977 7 p Filed 26 Apr. 1976 Sponsored by NASA

(NASA-Case-LEW-12608-1; US-Patent-4,033,705; US-Patent-Appl-SN-680067; US-Patent-Class-416-220R; US-Patent-Class-416-221) Avail: US Patent Office CSCL 21E

A retaining assembly is provided for locking radially extending blades in a rotor disc associated with a gas turbine engine. The assembly includes a pair of spaced apart lugs axially extending from one side of the disc to form an access gap for insertion of a blade tang into a dovetail slot in the rotor disc. A pair of axially aligned inwardly facing recesses are disposed in the lugs. A retaining member resides in the recesses and extends across the gap to preclude egress of the blade tang from the dovetail slot. The retaining member includes at least one axially extending protrusion adapted to radially overlap and abuttingly engage a radially inwardly facing abutment surface on the lugs.

Official Gazette of the U.S. Patent Office

N77-27117*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY STUDY OF A HYDROGEN PEROXIDE ROCKET FOR USE IN MOVING SOURCE JET NOISE TESTS

Robert M. Plencner [1977] 23 p ref

(NASA-TM-X-73678; E-9210) Avail: NTIS HC A02/MF A01 CSCL 20A

A preliminary investigation was made of using a hydrogen peroxide rocket to obtain pure moving source jet noise data. The thermodynamic cycle of the rocket was analyzed. It was found that the thermodynamic exhaust properties of the rocket could be made to match those of typical advanced commercial supersonic transport engines. The rocket thruster was then considered in combination with a streamlined ground car for moving source jet noise experiments. When a nonthrottlable hydrogen peroxide rocket was used to accelerate the vehicle, propellant masses and/or acceleration distances became too large. However, when a throttlable rocket or an auxiliary system was

used to accelerate the vehicle, reasonable propellant masses could be obtained. Author

N77-27118*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
AN INVESTIGATION OF COMBUSTION AND ENTROPY NOISE Final Report, 15 Jul. 1974 - 14 Jul. 1977
W. C. Strahle 15 Jul. 1977 97 p refs
(Grant NsG-3015)
(NASA-CR-135220) Avail: NTIS HC A05/MF A01 CSCL 21E

The relative importance of entropy and direct combustion noise in turbopropulsion systems and the parameters upon which these noise sources depend were studied. Theory and experiment were employed to determine that at least with the apparatus used here, entropy noise can dominate combustion noise if there is a sufficient pressure gradient terminating the combustor. Measurements included combustor interior fluctuating pressure, near and far field fluctuating pressure, and combustor exit plane fluctuating temperatures, as well as mean pressures and temperatures. Analysis techniques included spectral, cross-correlation, cross power spectra, and ordinary and partial coherence analysis. Also conducted were combustor liner modification experiments to investigate the origin of the frequency content of combustion noise. Techniques were developed to extract nonpropagational pseudo-sound and the heat release fluctuation spectra from the data. Author

N77-27119*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
ANALYSIS AND DOCUMENTATION OF QCSEE (QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE) OVER-THE-WING EXHAUST SYSTEM DEVELOPMENT Final Report
R. C. Ammer and J. T. Kutney Washington NASA Jun. 1977 144 p refs
(Contract NAS1-14270)
(NASA-CR-2792; R76AEG407) Avail: NTIS HC A07/MF A01 CSCL 21E

A static scale model test program was conducted in the static test area of the NASA-Langley 9.14- by 18.29 m(30- by 60-ft) Full-Scale Wind Tunnel Facility to develop an over-the-wing (OTW) nozzle and reverser configuration for the Quiet Clean Short-Haul Experimental Engine (QCSEE). Three nozzles and one basic reverser configuration were tested over the QCSEE takeoff and approach power nozzle pressure ratio range between 1.1 and 1.3. The models were scaled to 8.53% of QCSEE engine size and tested behind two 13.97-cm (5.5-in.) diameter tip-turbine-driven fan simulators coupled in tandem. An OTW nozzle and reverser configuration was identified which satisfies the QCSEE experimental engine requirements in terms of nozzle cycle area variation capability and reverse thrust level, and provides good jet flow spreading over a wing upper surface for achievement of high propulsive lift performance. Author

N77-27120# ARO, Inc., Arnold Air Force Station, Tenn.
TURBINE ENGINE MATHEMATICAL MODEL VALIDATION Final Report, 30 Aug. 1974 - 26 Sep. 1975
Lex Hutcheson AEDC Dec. 1976 41 p refs
(AD-A033302; ARO-ETF-TR-75-163; AEDC-TR-76-90) Avail: NTIS HC A03/MF A01 CSCL 21/5

This report presents and discusses the results of an investigation to develop a rationale and technique for the validation of turbine steady-state mathematical models for use in predicting flight test performance, stability, and durability parameters. A validation procedure is derived and demonstrated using the YJ101 prototype engine AEDC test results and status deck as an example application of the technique. Typical status deck uncertainties as a function of flight condition, engine power setting, and deck input parameters are given. Status deck flight test input error effects are also given. Author (GRA)

N77-27121# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
SUPERSONIC JET EXHAUST NOISE INVESTIGATION. VOLUME 1: SUMMARY REPORT Final Technical Report, 1 Dec. 1972 - 23 Sep. 1975
Paul R. Knott Wright-Patterson AFB, Ohio AFAPL Jul. 1976 137 p refs Sponsored in part by DOT 4 Vol.
(Contract F33615-73-C-2031; AF Proj. 3066)
(AD-A038682; R74AEG452-Vol-1; AFAPL-TR-76-68-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 20/1

This report summarizes major theoretical aerodynamic and acoustic developments and experimental findings aimed at providing a better understanding and a detailed mathematical specification of the noise-producing sources of simple exhaust jets. A review is given of calculation procedures for shock wave structure and flow field properties of simple circular jets. Results of new theoretical acoustic developments illustrating the influence of a jet's mean flow shrouding on jet acoustic radiation for unheated and heated jets are outlined. Additional discussions of interesting insights regarding the classical turbulent mixing theory of jet noise and the aeroacoustic formulations for a jet's orderly structure are given. Summaries of a series of high velocity, high temperature velocity field measurements using a General Electric developed laser velocimeter are discussed, and the application of the velocimeter for performing turbulence spectra and in-jet to far-field cross-correlation type measurements is reviewed. Key experiments illustrating the influence of swirl and combustion roughness on jet noise generation/reduction are presented. Results of high velocity and high temperature refraction experiments are also discussed, as well as discussions concerning jet flow amplifying effects of injected low frequency noise. Additionally, suggestions concerning shock-related noise as related to full-size engines are given. And finally, recommendations for future investigations are given. Author (GRA)

N77-27122# McDonnell Aircraft Co., St. Louis, Mo.
AIRCRAFT HYDRAULIC SYSTEMS DYNAMIC ANALYSIS. VOLUME 8: TRANSIENT THERMAL ANALYSIS (HYTTHA). COMPUTER PROGRAM TECHNICAL DESCRIPTION Interim Technical Report.
Ray Levek and Jeff Monroe Wright-Patterson AFB, Ohio AFAPL Feb. 1977 365 p refs
(Contract F33615-74-C-2016; AF Proj. 3145)
(AD-A038885; AFAPL-TR-76-43-Vol-8) Avail: NTIS HC A16/MF A01 CSCL 01/3

The Hydraulic Transient Thermal Analysis HYTTHA computer program has been developed to predict temperatures, and temperature gradients in hydraulic components and systems, due to changes in flow demands. The steady state flows and pressures throughout the system are used by the thermal portion of the program to predict fluid temperatures, line wall temperatures, component temperatures, and other component variables. The engineering input data to the program is normally available to a design engineer. Additional components, not covered here, may be added if necessary without much effort. Author (GRA)

N77-27123# Purdue Univ., Lafayette, Ind. Project SQUID Headquarters.
RESEARCH PROGRAMS IN AERODYNAMICS, TURBOMACHINERY, COMBUSTION, AND CHEMICAL KINETICS Semiannual Progress Report, 1 Oct. 1976 - 31 Mar. 1977
T. C. Adamson, Jr., James Broadwell, F. Browand, Edgar P. Bruce, and Franklin O. Carta 1 Apr. 1977 129 p refs
(Contract N00014-75-C-1143; Proj. SQUID)
(AD-A039002) Avail: NTIS HC A07/MF A01 CSCL 21/5

Reports of progress during the past six months on the 23 research programs comprising Project SQUID are presented. The research programs fall into the areas of Aerodynamics and Turbomachinery, Combustion and Chemical Kinetics, Measurements and Turbulence. Project SQUID is a cooperative program of basic research related to jet propulsion. It is administered by Purdue University and sponsored by the Office of Naval Research. Author (GRA)

N77-27124# RAND Corp., Santa Monica, Calif.
LIFE CYCLE ANALYSIS OF AIRCRAFT TURBINE ENGINES: EXECUTIVE SUMMARY Interim Report
J. R. Nelson Mar. 1977 63 p refs
(Contract F49620-77-C-0023)
(AD-A039062; R-2103/1-AF) Avail: NTIS HC A04/MF A01 CSCL 01/3

Presented is a methodology for life-cycle analysis of aircraft turbine engines that weapon-system planners can use to estimate certain performance/schedule/cost tradeoffs early in the design

and selection phase of acquiring this important subsystem. Prompted by the steadily escalating costs of engine acquisition and ownership, the study finds that engine life-cycle costs are much larger than and different from what had previously been realized. For example, depot costs alone will exceed procurement costs for a new engine with an operational lifespan of 15 years. Ownership-data availability being the most serious obstacle, the study recommends that the Air Force begin collecting and preserving disaggregated, homogeneous, longitudinal data at both depots and bases, associated with specific engine types. The findings also suggest numerous improvements in operational and maintenance procedures that the Air Force could adopt in the near term. The Air Force has already initiated studies in some of these areas. Author (GRA)

N77-27125# California Inst. of Tech., Pasadena. Guggenheim Jet Propulsion Center.

NOISE PRODUCED BY THE INTERACTION OF ACOUSTIC WAVES AND ENTROPY WAVES WITH HIGH-SPEED NOZZLE FLOWS Final Report

Mark S. Bohn Washington DOT May 1976 218 p refs (Contract DOT-OS-40057)

(PB-264989/5; DOT-TST-76-103) Avail: NTIS HC A10/MF A01 CSCL 21E

Some aspects of the noise generated internally by a turbojet engine are considered analytically and experimentally. The emphasis is placed on the interaction of pressure fluctuations and entropy fluctuations, produced by the combustion process in the engine, with gradients in the mean flow through the turbine blades or the exhaust nozzle. The results are directly applicable to the problem of excess noise in aircraft powerplants and suggest that the phenomenon described is the dominant mechanism. The one-dimensional interaction of pressure fluctuations and entropy fluctuations with a subsonic nozzle is solved analytically. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N77-27126*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

DEVELOPMENT OF A PARAMETER OPTIMIZATION TECHNIQUE FOR THE DESIGN OF AUTOMATIC CONTROL SYSTEMS Final Report

Philip H. Whitaker May 1977 125 p refs (Grant NGL-22-009-548)

(NASA-CR-143844; H-978) Avail: NTIS HC A06/MF A01 CSCL 01C

Parameter optimization techniques for the design of linear automatic control systems that are applicable to both continuous and digital systems are described. The model performance index is used as the optimization criterion because of the physical insight that can be attached to it. The design emphasis is to start with the simplest system configuration that experience indicates would be practical. Design parameters are specified, and a digital computer program is used to select that set of parameter values which minimizes the performance index. The resulting design is examined, and complexity, through the use of more complex information processing or more feedback paths, is added only if performance fails to meet operational specifications. System performance specifications are assumed to be such that the desired step function time response of the system can be inferred. Author

N77-27127*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

LINEAR TRACKING SYSTEMS WITH APPLICATIONS TO AIRCRAFT CONTROL SYSTEM DESIGN

Wing Hong Lee, Micahel Athans, David Castanon, and Frank Bacchioloni Jan. 1977 124 p refs (Grants NsG-1312; NSG-1018)

(NASA-CR-153281; ESL-R-720) Avail: NTIS HC A06/MF A01 CSCL 01C

A class of optimal linear time invariant tracking systems, both in continuous time and discrete time, of which the number of inputs (which are restricted to be step functions) is equal to the number of system outputs, is studied. Along with derivation of equations and design procedures, two discretization schemes are presented, constraining either the control or its time derivative, to be a constant over each sampling period. Descriptions are given for the linearized model of the F-8C aircraft longitudinal dynamics, and the C* handling qualities criterion, which then serve as an illustration of the applications of these linear tracking designs. A suboptimal reduced state design is also presented. Numerical results are given for both the continuous time and discrete time designs. Author

N77-27128# Westland Helicopters Ltd., Yeovil (England).

AN ANALYSIS OF THE GUIDANCE, CONTROL AND STABILITY OF AN AGGREGATE OF VEHICLES

A. E. Fowle Feb. 1977 60 p refs (RP-541) Avail: NTIS HC A04/MF A01

It is shown that both local and asymptotic stability can be assured by adequate damping referenced to terrain, i.e., by damping as a function of that component of the velocity of each vehicle which represents the difference between its actual and its demanded velocity relative to terrain. The analysis is applicable to all forms of ground, sea and air traffic under automatic control. The case of vehicles formating in line astern is examined. The magnitudes of the damping required to ensure local and asymptotic stability is established for both stable oscillatory and dead beat motions in terms of the spring stiffnesses represented by the accelerations required of the vehicles by the guidance and control systems. Author

N77-27129# Princeton Univ., N. J. Flight Research Lab.

A STUDY OF LIGHTPLANE STALL AVOIDANCE AND SUPPRESSION Final Report

David R. Ellis Feb. 1977 107 p refs (Contract DOT-FA74WA-3480)

(AD-A039223; FAA-RD-77-25) Avail: NTIS HC A06/MF A01 CSCL 01/2

The circumstances, causes, and factors which result in unintentional stalls at low altitude were examined. Extensive computer analysis of stall-related accidents for the period 1965-1973, flight evaluation of the low speed handling qualities and stall behavior of seven lightplanes, and generalized experiments to study pilot/airplane interactions in the high angle of attack regime using an in-flight simulator were conducted. The results indicate that further work is especially warranted in the areas of pilot education and training, stall warning systems, and application of new aerodynamic technology. In addition, renewed consideration should be given to the idea of limiting control power in non-acrobatic airplanes. Author

N77-27130*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF GYRO VERTICALITY ERROR ON LATERAL AUTOLAND TRACKING PERFORMANCE FOR AN INERTIALLY SMOOTHED CONTROL LAW

Jerry J. Thibodeaux Jun. 1977 19 p refs (NASA-TM-X-3545; L-11428) Avail: NTIS HC A02/MF A01 CSCL 17G

The results of a simulation study performed to determine the effects of gyro verticality error on lateral autoland tracking and landing performance are presented. A first order vertical gyro error model was used to generate the measurement of the roll attitude feedback signal normally supplied by an inertial navigation system. The lateral autoland law used was an inertially smoothed control design. The effect of initial angular gyro tilt errors (2 deg, 3 deg, 4 deg, and 5 deg), introduced prior to localizer capture, were investigated by use of a small perturbation aircraft simulation. These errors represent the deviations which could occur in the conventional attitude sensor as a result of the maneuver-induced spin-axis misalinement and drift. Results showed that for a 1.05 deg per minute erection rate and a 5 deg initial tilt error, ON COURSE autoland control logic was not satisfied. Failure to attain the ON COURSE mode precluded high control loop gains and localizer beam path integration and resulted in unacceptable beam standoff at touchdown. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

N77-27131* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

APPARATUS FOR DETERMINING THERMOPHYSICAL PROPERTIES OF TEST SPECIMENS Patent

Theodore R. Creel, Jr., Robert A. Jones, Richard R. Corwin (Beta Industries, Dayton, Ohio), and Joseph S. Kramer, inventors (to NASA) (Beta Industries, Dayton, Ohio) Issued 7 Jul. 1977 5 p Filed 27 Feb. 1967 Supersedes N76-18415 (14 - 09, p 1120)

(NASA-Case-LAR-11883-1; US-Patent-4,027,524; US-Patent-Appl-SN-662175; US-Patent-Class-73-15R) Avail: US Patent Office CSCL 14B

Apparatus is described for directly measuring the quantity square root of pck of a test specimen such as a wind tunnel model where p is density, c is the specific heat and k is the thermal conductivity of the specimen. The test specimen and a reference specimen are simultaneously subjected to the heat from a heat source. A thermocouple is attached to the reference specimen for producing a first electrical analog signal proportional to the heat rate Q that the test specimen is subjected to and an infrared radiometer that is aimed at the test specimen produces a second electrical analog signal proportional to the surface temperature T of the test specimen. An analog-to-digital converter converts the first and second electrical analog signals to digital signals. These digital signals are applied to a computer for determining the quantity.

Official Gazette of the U.S. Patent Office

N77-27132*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRELIMINARY TEST RESULTS OF THE JOINT FAA-USAF-NASA RUNWAY RESEARCH PROGRAM. PART 1: TRACTION MEASUREMENTS OF SEVERAL RUNWAYS UNDER WET AND DRY CONDITIONS WITH A BOEING 727, A DIAGONAL-BRAKED VEHICLE, AND A MU-METER

Walter B. Horne, Thomas J. Yager, Robert K. Sleeper, and Leslie R. Merritt (FAA) May 1977 123 p refs Sponsored in part by FAA and USAF

(NASA-TM-X-73909) Avail: NTIS HC A06/MF A01 CSCL 01E

The stopping distance, brake application velocity, and time of brake application were measured for two modern jet transports, along with the NASA diagonal-braked vehicle and the British Mu-Meter on several runways, which when wetted, cover the range of slipperiness likely to be encountered in the United States. Tests were designed to determine if correlation between the aircraft and friction measuring vehicles exists. The test procedure, data reduction techniques, and preliminary test results obtained with the Boeing 727, the Douglas DC-9, and the ground vehicles are given. Time histories of the aircraft test run parameters are included. Author

N77-27133*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRELIMINARY TEST RESULTS OF THE JOINT FAA-USAF-NASA RUNWAY RESEARCH PROGRAM. PART 2: TRACTION MEASUREMENTS OF SEVERAL RUNWAYS UNDER WET, SNOW COVERED, AND DRY CONDITIONS WITH A DOUGLAS DC-9, A DIAGONAL-BRAKED VEHICLE, AND A MU-METER

Walter B. Horne, Thomas J. Yager, Robert K. Sleeper, Eunice G. Smith, and Leslie R. Merritt (FAA) May 1977 341 p refs Sponsored in part by FAA and USAF

(NASA-TM-X-73910) Avail: NTIS HC A15/MF A01 CSCL 01E

For abstract, see N77-27132.

N77-27134*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NASA DIAGONAL-BRAKED TEST VEHICLE EVALUATION OF TRACTION CHARACTERISTICS OF GROOVED AND UNGROOVED RUNWAY SURFACES AT MIAMI INTERNATIONAL AIRPORT, MIAMI, FLORIDA, 8-9 MAY 1973

Walter B. Horne May 1977 53 p refs

(NASA-TM-X-73912) Avail: NTIS HC A04/MF A01 CSCL 01E

Two runways were evaluated under artificially wetted conditions with the NASA diagonal-braked vehicle (DBV). Results of the evaluation which included a pavement drainage analysis, a pavement skid resistance analysis, and a DBV wet/dry stopping distance ratio analysis indicated that the ungrooved runway surfaces had poor water drainage characteristics and poor skid resistance under wet conditions at high speeds especially in rubbercoated areas of the runways. Grooving runways to a transverse 1-1/4 x 1/4 x 1/4 inch pattern greatly improved both the water drainage and pavement skid resistance capability of these asphaltic concrete surfaces. Author

N77-27135*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PLASTIC (WIRE-COMBED) GROOVING OF A SLIP-FORMED CONCRETE RUNWAY OVERLAY AT PATRICK HENRY AIRPORT: AN INITIAL EVALUATION

Eugene C. Marlin (Peninsula Airport Commission) and Walter B. Horne May 1977 32 p refs

(NASA-TM-X-73913) Avail: NTIS HC A03/MF A01 CSCL 01E

A wire-comb technique is described for transversely grooving the surface of a freshly laid (plastic state) slip-formed concrete overlay installed at Patrick Henry Airport. This method of surface texturing yields better water drainage and pavement skid resistance than that obtained with an older conventional burlap drag concrete surface treatment installed on an adjacent portion of the runway. Author

N77-27136*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A HOT WIRE RADIANT ENERGY SOURCE FOR MAPPING THE FIELD OF VIEW OF A RADIOMETER

S. F. Edwards, W. F. Stewart, and D. S. Vann [1977] 20 p

(NASA-TM-74035) Avail: NTIS HC A02/MF A01 CSCL 14B

The design and performance of a calibration device that allows the measurement of a radiometer's field of view are described. The heart of the device is a heated 0.0254-mm (0.001-inch) diameter filament that provides a variable, isothermal line source of radiant energy against a cold background. By moving this discrete line source across the field of view of a radiometer, the radiometer's spatial response can be completely mapped. The use of a platinum filament provides a durable radiation source whose temperature is stable and repeatable to 10 K over the range of 600 to 1200 K. By varying the energy emitted by the filament, the field of view of radiometers with different sensitivities (or multiple channel radiometers) can be totally mapped. Author

N77-27137*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF LN2 INJECTION STATION LOCATION ON THE DRIVE FAN POWER AND LN2 REQUIREMENTS OF A CRYOGENIC WIND TUNNEL

Jerry B. Adcock Jun. 1977 19 p refs

(NASA-TM-X-74036) Avail: NTIS HC A02/MF A01 CSCL 14B

A theoretical analysis comparing the fan power and coolant (LN2) flow rates resulting from injection of the LN2 either upstream or downstream of the drive fan of a closed circuit transonic cryogenic tunnel is presented. The analysis is restricted to steady state tunnel operation and to the condition that the tunnel walls are adiabatic. The stagnation pressure and temperature range of the tunnel is from 1.0 to 8.8 atm and from 300 K to liquefaction temperature, respectively. Calculations are made using real gas properties of nitrogen. Results show that the fan power and LN2 flow rates are lower if the LN2 is injected upstream of the fan. The lower fan inlet temperature resulting from injecting

upstream of the fan has a greater influence on the power than does the additional mass flow going through the fan. Author

N77-27138*# District of Columbia Univ., Washington, D. C. Div. of Mathematics.
MEASUREMENT OF INSULATION INTEGRITY OF IUE CAMERA TUBE FACSIMILES BY PARTIAL DISCHARGES METHOD AND DIFFUSION OF GASES THROUGH VARIOUS SILICONE RUBBERS Final Technical Report, 15 Apr. 1976 - 15 Apr. 1977
Renate S. Bever 15 Apr. 1977 168 p refs
(Grant NGR-09-053-003)
(NASA-CR-153293) Avail: NTIS HC A08/MF A01 CSCL 14B

Several dummy tubes imitating the IUE Camera System design were encapsulated with Solithane 2, Conathane EN-11, Green and Black Hysols and SMRD 432. Various flaws were purposefully placed in some of these. Partial discharge testing in vacuum under direct voltage conditions was carried once a week for 12 weeks, 15 kv dc being applied during normal working hours for 40 hours duration per week. None of the units showed much damage during this time judging by the P.D. energy histograms. A more complete mathematical presentation is given on diffusion and permeation than previously. Measurements of diffusion constants for various silicone rubbers are carried out by the Time-Lag method and compared to other determinations in the literature. Calculations of the time required for diffusion through a thick wall are demonstrated in the long time approximation and for dimensions pertaining to void and wall sizes of a delamination problem in the LANDSAT-C vidicon tubes. An actual delaminated LANDSAT-C tube and some facsimiles are immersed in vacuum for long periods and tested for catastrophic breakdown due to diffusion of gas, by application of high voltage. Author

N77-27139*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HIGH REYNOLDS NUMBER RESEARCH
Donald D. Baals, ed. Washington 1977 185 p Workshop Proc. held at Hampton, Va., 27-28 Oct. 1976; sponsored in part by George Washington Univ.
(NASA-CP-2009) Avail: NTIS HC A09/MF A01 CSCL 02A

Fundamental aerodynamic questions for which high Reynolds number experimental capability is required are discussed. The operational characteristics and design features of the National Transonic Facility are reviewed. For individual titles, see N77-27140 through N77-27150.

N77-27140*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE TRANSONIC REYNOLDS NUMBER PROBLEM
J. Lloyd Jones *In* NASA Langley Res. Center High Reynolds Number Res. 1977 p 1-18 (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

Problems in modeling the complex interacting flow fields in the transonic speed regime are reviewed. The limitations of wind tunnel test capabilities are identified, and options for resolving the deficiency are examined. The evolution of the National Transonic Facility, and the various needs for research investigations to be done there are discussed. The relative priorities that should be given within and across subdisciplines for guidance in planning for the most effective use of the facility are considered. Author

N77-27141*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE NTF AS A NATIONAL FACILITY
Oran W. Nicks *In its* High Reynolds Number Res. 1977 p 19-51 refs (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

Activities which led to the definition of the National Transonic Facility and the general agreements reached regarding its use and operations are reviewed. Topics discussed include: redefinition of test requirements, development of low cost options, consideration of a single transonic facility using existing hardware if feasible, facility concept recommendations, and acquisition schedule proposals. A.R.H.

N77-27142*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CRYOGENIC WIND-TUNNEL TECHNOLOGY
Robert A. Kilgore *In its* High Reynolds Number Res. 1977 p 53-63 refs (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

The cryogenic concept and the advantages it offers with respect to achieving full scale Reynolds number in a moderate size tunnel at reasonable levels of dynamic pressure are described. Aspects which must be considered during the development of a facility that uses gaseous nitrogen as the test gas are examined. These include the properties of nitrogen, particularly at high pressure; isentropic expansion and normal shock flows in nitrogen; real gas ratios; and the problem of condensation. Sources of information on cryogenic technology are cited. Author

N77-27143*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRANSONIC WIND-TUNNEL WALL INTERFERENCE
William B. Kemp, Jr. *In its* High Reynolds Number Res. 1977 p 65-71 refs (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

A method for analyzing wall interference is described which avoids the assumption of linear superposition of perturbations in extracting the wall induced velocity field. Measurements of pressure distribution on or near the tunnel walls during the actual wind tunnel test, are imposed as boundary values to be matched. Instead of applying wall interference corrections to the wind tunnel data, some property of the wall is adjusted until a calculated interference free criterion is satisfied for each tunnel data point. The mode of operation for the National Transonic Facility, envisioned as a correctable interference transonic tunnel, combines the capability for accurate assessment of wall interference with a limited capability for wall control. A.R.H.

N77-27144*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE DESIGN OF MODELS FOR CRYOGENIC WIND TUNNELS
Vernon P. Gillespie *In its* High Reynolds Number Res. 1977 p 73-79 (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

Factors to be considered in the design and fabrication of models for cryogenic wind tunnels include high model loads imposed by the high operating pressures, the mechanical and thermodynamic properties of materials in low temperature environments, and the combination of aerodynamic loads with the thermal environment. Candidate materials are being investigated to establish criteria for cryogenic wind tunnel models and their installation. Data acquired from these tests will be provided to users of the National Transonic Facility. A.R.H.

N77-27145*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INSTRUMENTATION AND DATA ACQUISITION SYSTEMS
Joseph F. Guarino *In its* High Reynolds Number Res. 1977 p 81-101 refs (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

A comprehensive and integrated measurement system was identified and a design and development effort initiated to meet the criteria imposed by the National Transonic Facility operating environment. Specific measurement areas receiving concentrated attention include: data acquisition, force measurement, pressure instrumentation, flow visualization techniques, model attitude and model deformation measurement, and temperature measurement. The NTF instrument complex will be centered around four 32-bit, 1-microsecond-cycle-time central processing units connected in a multipoint-distributed network configuration. The principal activities to be supported by these computers are: (1) data base management and processing; (2) research measurement data acquisition and display; (3) tunnel and model control; and (4) process monitoring and communication control. The distributed network approach was chosen to modularize the functional software into definable and implementable parts by the various groups involved in the design and to permit use of similar hardware configurations to improve reliability and maintainability. Author

N77-27146*# National Aeronautics and Space Administration, Washington, D. C.
INTRODUCTORY REMARKS
Alfred Gessow *In* NASA Langley Res. Center High Reynolds Number Res. 1977 p 107-120 (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

Suggested fluid mechanics research to be conducted in the National Transonic Facility include: wind tunnel calibration; flat plate skin friction, flow visualization and measurement techniques; leading edge separation; high angle of attack separation; shock-boundary layer interaction; submarine shapes; low speed studies of cylinder normal to flow; and wall interference effects. These theoretical aerodynamic investigations will provide empirical inputs or validation data for computational aerodynamics, and increase the usefulness of existing wind tunnels. Author

N77-27147*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REPORT ON THE PANEL ON THEORETICAL AERODYNAMICS
Percy J. Bobbitt and James E. Carter *In its* High Reynolds Number Res. 1977 p 123-150 refs (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

Requirements for flow quality in the National Transonic Facility are explored. Viscous flow effects of concern to theoreticians are discussed. Experiments outlined for theory validation in the facility include validating high aspect ratio wing-body combination; low aspect ratio moderately swept wing; low aspect ratio highly swept wing; high lift systems on high aspect ration wings; Reynolds number scaling; dynamic shock- boundary layer interaction; and the effect of R and M on dynamic stall. A.R.H.

N77-27148*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTRODUCTORY REMARKS
Richard Whitcomb *In its* High Reynolds Number Res. 1977 p 153-161 (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

Advanced transonic configurations, such as the supercritical wing, are inherently more sensitive to Reynolds number than earlier configurations because the pressure recovery gradients imposed on the boundary layer are generally steeper. The results of two-dimensional supercritical airfoil investigations and theoretical calculations show this effect. A technique for approximately simulating full-scale Reynolds number characteristics at present wind-tunnel Reynolds numbers for near-cruise conditions is described. The transition strip, which in the past has been located near the leading edge of the wing, is rearward so that the relative displacement thickness of the boundary layer at the trailing edge of the wing is the same as might be expected on a full-scale configuration with the transition near the leading edge. Two-dimensional wind-tunnel results indicate that the technique provides a very good simulation of airfoil characteristics at full-scale Reynolds number. The need for sorting the effects of Reynolds number and aeroelasticity, which can be done in the NTF, is also addressed. Author

N77-27149*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE PANEL ON PROPULSION AERODYNAMICS
David Bowditch *In* NASA Langley Res. Center High Reynolds Number Res. 1977 p 165-171 (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

Sources of discrepancies noted between propulsion aerodynamic characteristics as predicted from wind tunnel tests and as measured in flight are discussed. The variable Reynolds capability of the National Transonic Facility will provide a tool for understanding and quantifying uncertainties involved in extrapolating the corrected wind tunnel data from tunnel conditions to full scale flight conditions. Author

N77-27150*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REPORT OF THE PANEL ON DYNAMICS AND AEROELASTICITY
John Houbolt *In its* High Reynolds Number Res. 1977 p 175-188 ref (For primary document see N77-27139 18-09)
Avail: NTIS HC A09/MF A01 CSCL 14B

Model scaling for flutter analysis is reviewed. Characteristics of the Langley Transonic Dynamics Tunnel (TDT) are described and several features are recommended for inclusion in the National Transonic Facility. Problem areas suggested for the NTF include: Reynolds number effects on control surface unsteady aerodynamics; effects of Reynolds number on buffet onset and loads; transonic unsteady aerodynamics; and Reynolds number effects on flutter characteristics of wing planforms and airfoils. A.R.H.

N77-27151# Naval Civil Engineering Lab., Port Hueneme, Calif.
EXTERNALLY GENERATED LIGHT (EGL) SYSTEMS FOR HYPERBARIC/HYPOBARIC CHAMBERS Final Report, Feb. 1972 - Aug. 1975
K. O. Gray Jan. 1977 56 p refs
(YF52556008)
(AD-A036917; CEL-TN-1469) Avail: NTIS HC A04/MF A01 CSCL 13/1

Lighting systems for hyperbaric/hypobaric chambers are described. Methods of interior illumination without introduction of any potential fire source in the chamber are presented. The systems utilize light generated outside of the chamber environment, filtered for reduction of infrared radiation, and then introduced through either large (viewport sized) or small (pipe sized) transparent hull penetrations. Accessory devices for use with externally generated lighting (EGL) systems are also described. Author (GRA)

N77-27152# Army Natick Research and Development Command, Mass.
OPERATION OF MILITARY FIELD HEATING EQUIPMENT USING SOLID FUELS Final Report
Cornelius J. McKeown Mar. 1977 45 p refs
(AD-A037121; NARADCOM-TR-76-61-AMEL) Avail: NTIS HC A03/MF A01 CSCL 21/4

In view of the present energy crisis and its impact on the use of liquid fuel, this project was undertaken to survey the present military heating equipment to determine its capabilities for burning solid fuels. This report describes standard military equipment and components for heating in field operations with solid fuel. Included in the report is a discussion of the handling and burning characteristics of solid fuels. The report concludes with twenty-two recommendations that should be considered. The increasing demand of liquid fuel needed for military combat equipment plus the uncertain supply of liquid fuel could result in a drastic reduction in the amount of liquid fuel available for field heating. Author (GRA)

N77-27153# Army Training Support Center, Fort Eustis, Va.
TEST AND EVALUATION OF THE ARMY'S CH-47 HELICOPTER FLIGHT SIMULATOR
Juri Toomepuu 18 Jan. 1977 27 p refs Presented at the 3d DOD/NASA Simulation Technol. Coordination Group Meeting, Naval Training Equipment Center, Orlando, Fla., 18 Jan. 1977
(AD-A036159) Avail: NTIS HC A03/MF A01 CSCL 05/9

This report gives an overview of the Army's current efforts to test and evaluate the prototype CH-47 Helicopter Flight Simulator (CH47FS). This effort includes a combined development and operational test (DT/OT II) and a Cost and Training Effectiveness Analysis (CTEA). The CH47FS is the first prototype of the Army's new generation flight simulators with six degrees of freedom motion systems which incorporate a video camera/terrain board visual system. The current evaluation represents a significant advance in the procedures and methods for validation of the Army's stated flight simulator requirements. During the operational test, transfer of training experiments will be conducted for both institutional and unit pilot training, and objective and subjective training effectiveness data will be collected. The CTEA, using data generated by the test, will evaluate the simulator cost and training effectiveness for various training packages, defined in terms of the extent of substitution of aircraft by simulator in pilot training. A Basis of Issue Plan (BOIP) model for flight simulators, based on mathematical programming techniques, will be developed, and a proposed BOIP for the CH47FS prepared as part of the CTEA. The report lists operational and technical issues for additional evaluation of flight simulators. Author (GRA)

N77-27154# Naval Training Equipment Center, Orlando, Fla.
COMPUTER SIMULATION OF FRESNEL LENS OPTICAL LANDING SYSTEM Technical Report, Jul. 1975 - Jun. 1976
Igor V. Golovcsenko Sep. 1976 47 p refs
(AD-A038456; NAVTRAEQUIPC-IH-265) Avail: NTIS HC A03/MF A01 CSCL 01/2

This report describes a computer simulation of a Fresnel Lens Optical Landing System (FLOLS). The simulation was a subtask of a carrier landing visual simulation. A description of the math model for duplicating the appearance and behavior of the real FLOLS system is provided. The computer generated visual display of the FLOLS was produced through an Evans and Sutherland Computer Corporation LDS-1 (Line Drawing System Model 1) calligraphic display system. Author (GRA)

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N77-27155*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SKYLAB, OUR FIRST SPACE STATION
Leland F. Belew, ed. Washington 1977 176 p
(NASA-SP-400) Avail: NTIS MF A01; SOD HC $7.00 CSCL 22A

The vast accomplishments of Skylab - in solar and stellar astronomy, in the detailed study of our planet from the incomparable vantage of orbit, in using the laboratory tool of weightlessness, and in proving that man can work productively in space for extended periods - are discussed. The data on solar physics contain valuable information on the Sun's corona and the solar winds and open up new concepts to be explored in future solar astronomy programs. In the area of technology, the data from Skylab's space processing experiments open a completely new dimension in the field of materials processing. Author

N77-27156*# Boeing Aerospace Co., Seattle, Wash.
LARGE SPACE ERECTABLE STRUCTURES - BUILDING BLOCK STRUCTURES STUDY Final Report
W. H. Armstrong, D. E. Skoumal, and J. W. Straayer Apr. 1977 119 p refs
(Contract NAS9-14914)
(NASA-CR-151449; D-180-20607-2) Avail: NTIS HC A06/MF A01 CSCL 22A

A modular planar truss structure and a long slender boom concept identified as building block approaches to construction of large spacecraft configurations are described. The concepts are compatible in weight and volume goals with the Space Transportation System, use standard structural units, and represent high on-orbit productivity in terms of structural area or beam length. Results of structural trade studies involving static and dynamic analyses of a single module and rigid body deployment analyses to assess kinetics and kinematics of automatic deployment of the building block modules are presented. J.M.S.

N77-27157*# Martin Marietta Corp., Denver, Colo.
ORBITAL CONSTRUCTION SUPPORT EQUIPMENT Final Report
Jun. 1977 437 p refs
(Contract NAS9-15120)
(NASA-CR-151460; MCR-77-234) Avail: NTIS HC A19/MF A01 CSCL 22A

Approximately 200 separate construction steps were defined for the three solar power satellite (SPS) concepts. Detailed construction scenarios were developed which describe the specific tasks to be accomplished, and identify general equipment requirements. The scenarios were used to perform a functional analysis, which resulted in the definition of 100 distinct SPS elements. These elements are the components, parts, subsystems, or assemblies upon which construction activities take place. The major SPS elements for each configuration are shown. For those elements, 300 functional requirements were identified in seven generic processes. Cumulatively, these processes encompass all functions required during SPS construction/assembly. Individually each process is defined such that it includes a specific type of activity. Each SPS element may involve activities relating to any or all of the generic processes. The processes are listed, and examples of the requirements defined for a typical element are given. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N77-27158*# Old Dominion Univ. Research Foundation, Norfolk, Va.
RADIATION INDUCED PRECURSOR FLOW FIELD AHEAD OF A JOVIAN ENTRY BODY Final Report
S. Tiwari and K. Y. Szema Apr. 1977 94 p refs
(Contract NAS1-11707)
(NASA-CR-145221) Avail: NTIS HC A05/MF A01 CSCL 22C

The change in flow properties ahead of the bow shock of a Jovian entry body, resulting from absorption of radiation from the shock layer, is investigated. Ultraviolet radiation is absorbed by the free stream gases, causing dissociation, ionization, and an increase in enthalpy of flow ahead of the shock wave. As a result of increased fluid enthalpy, the entire flow field in the precursor region is perturbed. The variation in flow properties is determined by employing the small perturbation technique of classical aerodynamics as well as the thin layer approximation for the preheating zone. By employing physically realistic models of radiative transfer, solutions are obtained for velocity, pressure, density, temperature, and enthalpy variations. The results indicate that the precursor flow effects, in general, are greater at higher altitudes. Just ahead of the shock, however, the effects are larger at lower altitudes. Pre-heating of the gas significantly increases the static pressure and temperature ahead of the shock for velocities exceeding 36 km/sec. Author

N77-27159# Naval Surface Weapons Center, Dahlgren, Va.
NAVAL SURFACE WEAPONS CENTER REDUCTION AND ANALYSIS OF DOPPLER SATELLITE RECEIVERS USING THE CELEST COMPUTER PROGRAM Final Report
James W. OToole Mar. 1977 41 p refs
(AD-A038453; NSWC/DL-TR-3627) Avail: NTIS HC A03/MF A01 CSCL 09/2

The CELEST Computer Program uses raw Doppler data to determine satellite orbits. It provides diagnostic information on the quality of the orbits and the data used in producing those orbits. The basic technique employed is one of weighted least squares where the data is edited and weighted within the program. An iterative capability exists for nonlinear problems. Trajectories are formed by directly integrating the equations of motion in an inertial frame. The force equation has components due to earth, sun, and moon gravity, solar radiation, thrust, atmospheric drag, solar and lunar tidal distortion. A satellite frequency offset error can be determined, and the program has the facility for determining unknown receiver locations. The computer program occupies 130 K octal units of memory, is structured as nine major overlays, and is completely written in FORTRAN. The program is primarily operated on a sixty bit CDC 6700 computer. GRA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

N77-27160*# Kanner (Leo) Associates, Redwood City, Calif.
AUTOMATIC STATIONS TO STUDY THE LUNAR SURFACE

A. L. Kemurdzhian, V. V. Gromov, I. I. Cherrasov, and V. V. Shvarev Washington NASA Jul. 1977 227 p refs Transl. into ENGLISH of the book "Avtomaticheskiye stantsii dlya izucheniya poverkhnostnogo pokrova luny", Moscow, Mashinostroyeniye Press, 1976 200 p
(Contract NASw-2790)
(NASA-TT-F-17545) Avail: NTIS HC A11/MF A01 CSCL 14B

Automatic stations for studying the surface of the moon and equipment for sampling lunar soils are described. Methods and results for studying the physical and mechanical properties of the soils are presented. A method of simulating the lunar conditions is presented in examples of earth development of the self-propelled chassis of lunokhods; also, test stands and operating tests on earth are presented. Author

N77-27161*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
STUDY OF LYNDON B. JOHNSON SPACE CENTER UTILITY SYSTEMS
Tony E. Redding and William C. Huber Jun. 1977 127 p refs
(NASA-TM-58196) Avail: NTIS HC A07/MF A01 CSCL 14B

The results of an engineering study of potential energy saving utility system modifications for the NASA Lyndon B. Johnson Space Center are presented. The objective of the study was to define and analyze utility options that would provide facility energy savings in addition to the approximately 25 percent already achieved through an energy loads reduction program. A systems engineering approach was used to determine total system energy and cost savings resulting from each of the ten major options investigated. The results reported include detailed cost analyses and cost comparisons of various options. Cost are projected to the year 2000. Also included are a brief description of a mathematical model used for the analysis and the rationale used for a site survey to select buildings suitable for analysis. Author

N77-27162*# Lockheed Electronics Co., Houston, Tex. Systems and Services Div.
RMS MASSLESS ARM DYNAMICS CAPABILITY IN THE SVDS
H. A. Flanders Jun. 1977 34 p refs
(Contract NAS9-15200)
(NASA-CR-151458; JSC-12632; LEC-10633) Avail: NTIS HC A03/MF A01 CSCL 14B

The equations of motion for the remote manipulator system, assuming that the masses and inertias of the arm can be neglected, are developed for implementation into the space vehicle dynamics simulation (SVDS) program for the Orbiter payload system. The arm flexibility is incorporated into the equations by the computation of flexibility terms for use in the joint servo model. The approach developed in this report is based on using the Jacobian transformation matrix to transform force and velocity terms between the configuration space and the task space to simplify the form of the equations. Author

N77-27163# ARO, Inc., Arnold Air Force Station, Tenn.
EXPERIMENTAL DATA IN SUPPORT OF A MAGNETIC-GUIDEWAY/GUIDED-PROJECTILE SYSTEM CONCEPT FOR AEROBALLISTIC RANGES Final Report, Jul. 1973 - Sep. 1976
G. D. Arney, Jr. and C. W. Pender, Jr. AEDC Feb. 1977 72 p refs
(AD-A036001; ARO-VKF-TR-76-111; AEDC-TR-76-148) Avail: NTIS HC A04/MF A01 CSCL 17/7

Two types of experiments have been conducted to determine adequacy of theory relative to a previously reported system concept for the incorporation of magnetic projectile guidance into aeroballistic ranges. The concept is based on motion-induced electrodynamic interactions between conductive material in the forebody of projectiles and a guideway of field source currents. By using a rotating machinery apparatus, one set of experiments was conducted to simulate the interaction between a projectile forebody and the guideway currents to the extent that predicted positional forces could be measured. These forces which are intended to act toward the guideway axis as a function of lateral forebody position were in agreement with theory. Through use of a pendulum apparatus, another set of experiments was conducted to simulate interactions to the extent that predicted damping forces as needed for retardation of lateral forebody motion could be measured. Again, the results were in agreement with theoretical predictions. Author

N77-27164# Range Commanders Council, White Sands Missile Range, N. Mex. Range Safety Group.
REAL-TIME METHODS OF INSTRUMENTATION COMBINATION AND DATA SELECTION FOR RANGE SAFETY CALCULATIONS Final Report
Apr. 1977 62 p
(AD-A038789; RSG-314-72; DOC-314-77) Avail: NTIS HC A04/MF A01 CSCL 16/1

A survey of seven of the test ranges represented in the Range Safety Group (RSG) of the Range Commanders Council (RCC) was made to determine the real-time methods of selection and combination currently in use at the various ranges. This information is presented in this document to assist all ranges in determining which systems may have merit for their application and to provide some insight into future applications.
Author (GRA)

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N77-27165*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA/ESACV-990 SPACELAB SIMULATION. APPENDIX B: EXPERIMENT DEVELOPMENT AND PERFORMANCE Final Report
John O. Reller, Carr B. Neel, and Louis C. Haughney Dec. 1976 170 p refs
(NASA-TM-73205; A-6669) Avail: NTIS HC A08/MF A01 CSCL 22A

Eight experiments flown on the CV-990 airborne laboratory during the NASA/ESA joint Spacelab simulation mission are described in terms of their physical arrangement in the aircraft, their scientific objectives, developmental considerations dictated by mission requirements, checkout, integration into the aircraft, and the inflight operation and performance of the experiments.
Author

N77-27166*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VIKING ORBITER SYSTEM PRIMARY MISSION Performance Report, 20 Aug. 1975 - 15 Nov. 1976
J. R. Goudy 15 Jun. 1977 320 p
(Contract NAS7-100)
(NASA-CR-153744; VFT-022) Avail: NTIS HC A14/MF A01 CSCL 22A

An overview of Viking Orbiter (VO) system and subsystem peformances during the primary mission (the time period from VO-1 launch on August 20, 1975, through November 15, 1976) is presented. Brief descriptions, key design requirements, pertinent historical information, unique applications or situations, and predicted versus actual performances are included for all VO-1 and VO-2 subsystems, both individually and as an integrated system. Author

N77-27167*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 17, NO. 2
30 Apr. 1977 41 p
(NASA-TM-74721) Avail: NTIS HC A03/MF A01 CSCL 05B

Space objects in orbit are listed as well as those which decayed during the reporting period. Data provided include international designation and catalog number, nation of source, launch date, and inclination, apogee and perigee. Transmitting frequencies for satellites being monitored by NASA space flight tracking and data network are given. Author

N77-27168*# Lockheed Electronics Co., Houston, Tex.
THE STATUS OF ENVIRONMENTAL SATELLITES AND

AVAILABILITY OF THEIR DATA PRODUCTS
C. L. Hughes and C. E. Campbell Mar. 1977 152 p refs
(Contract NAS9-15200)
(NASA-CR-151459; JSC-12706; LEC-10344) Avail: NTIS HC A08/MF A01 CSCL 22B

The latest available information about the status of unclassified environmental satellite (flown by the United States) and their data products is presented. The type of environmental satellites discussed include unmanned earth resource and meteorological satellites, and manned satellites which can act as a combination platform for instruments. The capabilities and data products of projected satellites are discussed along with those of currently operating systems. Author

N77-27169*# Rice Univ., Houston, Tex.
AN INVESTIGATION OF THE NEEDS AND THE DESIGN OF AN ORBITING SPACE STATION WITH GROWTH CAPABILITIES Final Report
John R. Dossey and Guillermo Trotti Jan. 1977 103 p
(Contract NASw-2776)
(NASA-CR-151450; RUSSSTUDY-5) Avail: NTIS HC A06/MF A01 CSCL 22B

An architectural approach to the evolutionary growth of an orbiting space station from a small manned satellite to a fully independent, self-sustainable space colony facility is presented. Social and environmental factors, ease of transportation via the space shuttle, and structural design are considered. J.M.S.

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Tecnnology and Transportation*.

N77-27170*# Battelle Columbus Labs., Ohio.
THE STS PILOT USER DEVELOPMENT PROGRAM Supplementary Final Report
J. R. McDowell 30 Jun. 1977 29 p
(Contract NASw-2964)
(NASA-CR-153701) Avail: NTIS HC A03/MF A01 CSCL 22A

The planning and preparation activities and the results of the briefings associated with the Paris Air Show are described. A team of key personnel were available during the show to familiarize international users with the STS program and the space shuttle capabilities. Participation at the show included the operation of an STS booth at the U.S. pavilion, the presentation of several invitational briefings, and detailed discussions with individual organizations. B.B.

N77-27171*# Lockheed Electronics Co., Houston, Tex.
SPACE TRANSPORTATION SYSTEM/CARGO MASS PROPERTIES CALCULATION USING AN INTERACTIVE SYSTEM
G. G. Downs and R. R. Miley 16 Jun. 1977 35 p refs
(Contract NAS9-15200)
(NASA-CR-151437; JSC-12635; LEC-10705; SEPO-139-32) Avail: NTIS HC A03/MF A01 CSCL 22A

The methodology used to perform STS cargo mass properties calculations using an interactive computer system is described. Author

N77-27172*# Aerospace Corp., El Segundo, Calif. Advanced Mission Analysis Directorate.
STS ANCILLARY EQUIPMENT STUDY Final Report
James A. Plough May 1977 40 p refs
(Contract NASw-2884)
(NASA-CR-153745; ATR-77(7373-02)-1) Avail: NTIS HC A03/MF A01 CSCL 22A

Spaceborne and ground ancillary equipment for multimission module spacecraft are listed to provide documentation for potential users interested in utilizing existing equipment rather than developing payload unique designs. The format of the data form contained in the Ancillary Equipment user reference book is discussed. Author

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

N77-27173*# Scientific Translation Service, Santa Barbara, Calif.
TRAJECTORY AND GUIDANCE PARAMETERS IN FLIGHT CONTROL OF THE VENERA 9 AND VENERA 10 SPACECRAFT
S. K. Abramovich Washington NASA Jun. 1977 14 p Transl. into ENGLISH from Kosmicheskiye Issledovaniya (Moscow), v. 14, no. 5, 1976 p 667-673
(Contract JPL-954698)
(NASA-TM-75120) Avail: NTIS HC A02/MF A01 CSCL 22A

The flight plans of the Venera 9 and Venera 10 spacecraft are discussed in terms of trajectory control and guidance. Results obtained from real time analysis to determine and predict the satellites' trajectories show good agreement between the actual and the design orbit evolution. J.M.S.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

No abstracts in this category.

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N77-27174*# Applied Science Associates, Inc., Apex, N.C.
ALTIMETER WAVEFORM SOFTWARE DESIGN Final Report
G. S. Hayne, L. S. Miller, and G. S. Brown Jun. 1977 128 p refs
(Contract NAS6-2520)
(NASA-CR-141419) Avail: NTIS HC A07/MF A01 CSCL 14B

Techniques are described for preprocessing raw return waveform data from the GEOS-3 radar altimeter. Topics discussed include: (1) general altimeter data preprocessing to be done at the GEOS-3 Data Processing Center to correct altimeter waveform data for temperature calibrations, to convert between engineering and final data units and to convert telemetered parameter quantities to more appropriate final data distribution values: (2) time 'tagging' of altimeter return waveform data quantities to compensate for various delays, misalignments and calculational intervals; (3) data processing procedures for use in estimating spacecraft attitude from altimeter waveform sampling gates; and (4) feasibility of use of a ground-based reflector or transponder to obtain in-flight calibration information on GEOS-3 altimeter performance. GRA

N77-27175*# Applied Science Associates, Inc., Apex, N.C.
INITIAL TEST RESULTS USING THE GEOS-3 ENGINEERING MODEL ALTIMETER Final Report

G. S. Hayne and J. B. Clary Jun. 1977 133 p refs
(Contract NAS6-2520)
(NASA-CR-141421) Avail: NTIS HC A07/MF A01 CSCL 14B

Data from a series of experimental tests run on the engineering model of the GEOS 3 radar altimeter using the Test and Measurement System (TAMS) designed for preflight testing of the radar altimeter are presented. These tests were conducted as a means of preparing and checking out a detailed test procedure to be used in running similar tests on the GEOS 3 protoflight model altimeter systems. The test procedures and results are also included. Author

N77-27176*# Dudley Observatory, Latham, N. Y.
DEVELOPMENT OF A MICROBALANCE SUITABLE FOR SPACE APPLICATION Final Report
Harvey Patashnick and Georg Rupprecht 24 Jun. 1977 73 p
(Contract NAS8-31359)
(NASA-CR-150334) Avail: NTIS HC A02/MF A01 CSCL 14B

The tapered element oscillating microbalance (TEOM), an ultrasensitive mass measurement device which is suitable for both particulate and vapor deposition measurements is described. The device can be used in contamination measurements, surface reaction studies, particulate monitoring systems or any micro-weighing activity where either laboratory or field monitoring capability is desired. The active element of the TEOM consists of a tube or reed constructed of a material with high mechanical quality factor and having a special taper. The element is firmly mounted at the wide end while the other end supports a substrate surface which can be composed of virtually any material. The tapered element with the substrate at the free (narrow) end is set into oscillation in a clamped free mode. A feedback system maintains the oscillation whose natural frequency will change in relation to the mass deposited on the substrate. Author

N77-27177*# Ball Bros. Research Corp., Boulder, Colo. Aerospace Div.
PANORAMIC ATTITUDE SENSOR Final Engineering Report, period ending Nov. 1976
Ivan C. Meek Dec. 1976 315 p
(Contract NAS5-20651)
(NASA-CR-152549) Avail: NTIS HC A14/MF A01 CSCL 14B

Each subassembly, design analysis, and final calibration data on all assemblies for the Panormic Attitude Sensor (PAS) are described. The PAS is used for course attitude determination on the International Ultraviolet Explorer Spacecraft (IUE). The PAS contains a sun sensor which is sensitive only to the sun's radiation and a mechanically scanned sensor which is sensitive to the earth, moon, and the sun. The signals from these two sensors are encoded and sent back in the telemetry data stream to determine the spacecraft attitude. Author

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N77-27178*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
PROBABILISTIC FRACTURE MECHANICS AND OPTIMUM FRACTURE CONTROL ANALYTICAL PROCEDURES FOR A REUSABLE SOLID ROCKET MOTOR CASE Final Report
S. Hanagud and B. Uppaluri Jun. 1977 38 p refs
(Contract NAS8-30617)
(NASA-CR-150131; E-16-646) Avail: NTIS HC A03/MF A01 CSCL 21H

A methodology for the reliability analysis of a reusable solid rocket motor case is discussed. The analysis is based on probabilistic fracture mechanics and probability distribution for initial flaw sizes. The developed reliability analysis is used to select the structural design variables of the solid rocket motor case on the basis of minimum expected cost and specified reliability bounds during the projected design life of the case. Effects of failure prevention plans such as nondestructive inspection and the material erosion between missions are also considered in the developed procedure for selection of design variables. The reliability-based procedure can be modified to consider other similar structures of reusable space vehicle systems with different failure prevention plans. Author

N77-27179*# Aerojet Liquid Rocket Co., Sacramento, Calif.
SPACE SHUTTLE ORBITAL MANEUVERING ENGINE PLATELET INJECTOR PROGRAM Final Report
1 Dec. 1975 322 p refs
(Contract NAS9-13133)
(NASA-CR-151442; Rept-13133-F-1) Avail: NTIS HC A14/MF A01 CSCL 21H

A platelet face injector for the Orbit Maneuvering Engine (OME) on the space shuttle was evaluated as a means of obtaining additional design margin and lower cost. The program was conducted in three phases. The first phase evaluated single injection elements, or unielements; it involved visual flow studies, mixing experiments using propellant simulants, and hot firings to assess combustion efficiency, chamber wall compatibility, and injector face temperatures. In the second phase, subscale units producing 600 lbf thrust were used to further evaluate the orifice patterns chosen on the basis of unielement testing. In addition to combustion efficiency, chamber and injector heat transfer, the subscale testing provided a preliminary indication of injector stability. Full scale testing of the selected patterns at 6,000 lbf thrust was performed in the third phase. Performance, heat transfer, and combustion stability were evaluated over the anticipated range of OMS operating conditions. The effects on combustion stability of acoustic cavity configuration, including cavity depth, open area, inlet contour, and other parameters, were investigated. Author

N77-27180*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NEAR NOISE FIELD CHARACTERISTICS OF NIKE ROCKET MOTORS FOR APPLICATION TO SPACE VEHICLE PAYLOAD ACOUSTIC QUALIFICATION
David A. Hilton and Dempsey Bruton (NASA, Wallops Flight Center) Jun. 1977 26 p refs Presented at the 93d Meeting of the Acoust. Soc. of Am., Pennsylvania State Univ., 6-10 Jun. 1977
(NASA-TM-X-72777) Avail: NTIS HC A03/MF A01 CSCL 21H

Results of a series of noise measurements that were made under controlled conditions during the static firing of two Nike solid propellant rocket motors are presented. The usefulness of these motors as sources for general spacecraft noise testing was assessed, and the noise expected in the cargo bay of the orbiter was reproduced. Brief descriptions of the Nike motor, the general procedures utilized for the noise tests, and representative noise data including overall sound pressure levels, one third octave band spectra, and octave band spectra were reviewed. Data are presented on two motors of different ages in order to show the similarity between noise measurements made on motors having different loading dates. The measured noise from these tests is then compared to that estimated for the space shuttle orbiter cargo bay. Author

N77-27181*# Boeing Aerospace Co., Huntsville, Ala.
SOLID ROCKET BOOSTER PERFORMANCE EVALUATION MODEL. VOLUME 1: ENGINEERING DESCRIPTION
7 Sep. 1974 351 p refs 4 Vol.
(Contract NAS8-29643)
(NASA-CR-150335; D256-10020-1-Vol-1) Avail: NTIS HC A16/MF A01 CSCL 21H

The space shuttle solid rocket booster performance evaluation model (SRB-II) is made up of analytical and functional simulation techniques linked together so that a single pass through the model will predict the performance of the propulsion elements of a space shuttle solid rocket booster. The available options allow the user to predict static test performance, predict nominal and off nominal flight performance, and reconstruct actual flight

and static test performance. Options selected by the user are dependent on the data available. These can include data derived from theoretical analysis, small scale motor test data, large motor test data and motor configuration data. The user has several options for output format that include print, cards, tape and plots. Output includes all major performance parameters (Isp, thrust, flowrate, mass accounting and operating pressures) as a function of time as well as calculated single point performance data. The engineering description of SRB-II discusses the engineering and programming fundamentals used, the function of each module, and the limitations of each module. Author

N77-27182*# Boeing Aerospace Co., Huntsville, Ala.
SOLID ROCKET BOOSTER PERFORMANCE EVALUATION MODEL. VOLUME 2: USERS MANUAL
7 Sep. 1974 191 p 4 Vol.
(Contract NAS8-29643)
(NASA-CR-150336; D256-10020-2-Vol-2) Avail: NTIS HC A09/MF A01 CSCL 21H

This users manual for the solid rocket booster performance evaluation model (SRB-II) contains descriptions of the model, the program options, the required program inputs, the program output format and the program error messages. SRB-II is written in FORTRAN and is operational on both the IBM 370/155 and the MSFC UNIVAC 1108 computers. Author

N77-27183*# Boeing Aerospace Co., Huntsville, Ala.
SOLID ROCKET BOOSTER PERFORMANCE EVALUATION MODEL. VOLUME 3: SAMPLE CASE
7 Sep. 1974 268 p 4 Vol.
(Contract NAS8-29643)
(NASA-CR-150337; D256-10020-3-Vol-3) Avail: NTIS HC A12/MF A01 CSCL 21H

The solid rocket booster performance evaluation model (SRB-11) is used to predict internal ballistics in a sample motor. This motor contains a five segmented grain. The first segment has a 14 pointed star configuration with a web which wraps partially around the forward dome. The other segments are circular in cross-section and are tapered along the interior burning surface. Two of the segments are inhibited on the forward face. The nozzle is not assumed to be submerged. The performance prediction is broken into two simulation parts: the delivered end item specific impulse and the propellant properties which are required as inputs for the internal ballistics module are determined; and the internal ballistics for the entire burn duration of the motor are simulated. Author

N77-27184*# Boeing Aerospace Co., Huntsville, Ala.
SOLID ROCKET BOOSTER PERFORMANCE EVALUATION MODEL. VOLUME 4: PROGRAM LISTING
7 Sep. 1974 934 p 4 Vol.
(Contract NAS8-29643)
(NASA-CR-150338; D256-10020-4-Vol-4) Avail: NTIS HC A99/MF A01 CSCL 21H

All subprograms or routines associated with the solid rocket booster performance evaluation model are indexed in this computer listing. An alphanumeric list of each routine in the index is provided in a table of contents. Author

N77-27185*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPERATIONAL COMPATIBILITY OF 30-CENTIMETER-DIAMETER ION THRUSTER WITH INTEGRALLY REGULATED SOLAR ARRAY POWER SOURCE
Suzanne T. Gooder Jul. 1977 26 p refs
(NASA-TN-D-8428; E-9072) Avail: NTIS HC A03/MF A01 CSCL 21C

System tests were performed in which Integrally Regulated Solar Arrays (IRSA's) were used to directly power the beam and accelerator loads of a 30-cm-diameter, electron bombardment, mercury ion thruster. The remaining thruster loads were supplied from conventional power-processing circuits. This combination of IRSA's and conventional circuits formed a hybrid power processor. Thruster performance was evaluated at 3/4- and 1-A beam currents with both the IRSA-hybrid and conventional power processors and was found to be identical for both systems. Power processing is significantly more efficient with the hybrid system. System dynamics and IRSA response to thruster arcs are also examined. Author

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N77-27186*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INFLUENCE OF TEMPERATURE AND THE ROLE OF CHROMIUM ON THE KINETICS OF SULFIDATION OF 310 STAINLESS STEEL
D. Bhogeswara Rao and Howard G. Nelson Mar. 1977 44 p refs
(NASA-TM-73246; A-7058) Avail: NTIS HC A03/MF A01 CSCL 07C

The sulfidation of 310 stainless steel was studied over the temperature range from 910 K to 1285 K. By adjusting the ratio of hydrogen sulfide, variations in sulfur potential were obtained. The effect of temperature on sulfidation was determined at three different sulfur potentials: 39/sqNm, 0.014/sqNm, and 0.00015/sqNm. All sulfide scales contained one or two surface layers in addition to a subscale. The second outer layer (OL-II), furthest from the alloy, contained primarily Fe-Ni-S. The first outer layer (OL-I), nearest the subscale, contained FE-Cr-S. The subscale consisted of sulfide inclusions in the metal matrix. At a given temperature and sulfur potential, the weight gain data obeyed the parabolic rate law after an initial transient period. The parabolic rate constants obtained at the sulfur potential of 39/sqNm did not show a break when the logarithm of the rate constant was plotted as a function of the inverse of absolute temperature. Sulfidation carried out at sulfur potentials below 0.02/sqNm, however, did show a break at 1145 K, which is termed as the transition temperature. This break was found to be associated with the changes which had occurred in the Fe:Cr ratio of OL-I. Below the transition temperature the activation energy was found to be approximately 125 kj/mole. Above the transition temperature the rate of sulfidation decreased with temperature but dependent on the Fe:Cr ratio in the iron-chromium-sulfide layers of the OL-I. A reaction mechanism consistent with the experimental results has been proposed. Author

24 COMPOSITE MATERIALS

Includes laminates.

N77-27187* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METHOD OF GROWING COMPOSITES OF THE TYPE EXHIBITING THE SORET EFFECT Patent
Biliyar N. Bhat, inventor (to NASA) (NAS - NRC) Issued 14 Jun. 1977 7 p Filed 11 Mar. 1975 Supersedes N75-19380 (13 - 11, p 1217) Sponsored by NASA
(NASA-Case-MFS-22926-1; US-Patent-4,029,500; US-Patent-Appl-SN-557565; US-Patent-Class-75-135; US-Patent-Class-75-65R; US-Patent-Class-75-139; US-Patent-Class-164-60) Avail: US Patent Office CSCL 11D

A predetermine amount of segregation is introduced into a molten sample of a composite that exhibits the Soret effect, such amount approximating the amount of segregation resulting from directional solidification of the sample. The molten sample is then directionally solidified starting at the end opposite the end richer in the constituent that would migrate toward the cooler part of a liquid solution of the composite maintained in a temperature gradient. Since solidification commences at the end deficient in such constituent, its migration toward the interface between the solid and liquid during the solidification will compensate for the deficiency, yielding a more homogeneous product. Official Gazette of the U.S. Patent Office

N77-27188* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HYBRID COMPOSITE LAMINATE STRUCTURES Patent
Christos C. Chamis and Raymond F. Lark, inventors (to NASA) Issued 14 Jun. 1977 12 p Filed 24 Sep. 1975 Supersedes N75-32180 (13 - 23, p 2886)
(NASA-Case-LEW-12118-1; US-Patent-4,029,838; US-Patent-Appl-SN-616332; US-Patent-Class-428-301; US-Patent-Class-428-328; US-Patent-Class-428-368; US-Patent-Class-428-418; US-Patent-Class-428-457; US-Patent-Class-428-902; US-Patent-Class-428-911) Avail: US Patent Office CSCL 11D

An invention which relates to laminate structures and specifically to essentially anisotropic fiber composite laminates is described. Metal foils are selectively disposed within the laminate to produce increased resistance to high velocity impact, fracture, surface erosion, and other stresses within the laminate. Official Gazette of the U.S. Patent Office

N77-27189*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
TWO-DIMENSIONAL HYGROTHERMAL DIFFUSIONS INTO A FINITE WIDTH COMPOSITE LAMINATE Interim Report
Gary L. Farley and Carl T. Herakovich Jun. 1977 30 p refs
(Contract NGR-47-004-129)
(NASA-CR-153698; IR-9; VPI-E-77-20) Avail: NTIS HC A03/MF A01 CSCL 11D

Two dimensional hygroscopic diffusion into composite laminates with free edges was obtained through the use of a second order finite difference scheme. A computer program was developed for the transient nonlinear coupled hygrothermal diffusion into finite width laminates with varying surface conditions along two edges. The formulation permits the diffusion coefficient to be a function of temperature, moisture concentration, and fiber orientation. The moisture distributions thus obtained are necessary for analysis of the moisture induced interlaminar stresses in the vicinity of free edges. It is shown that large diffusion times tend to eliminate the significance of stacking sequence, but gradients within and between layers are significant for all diffusion times. Author

N77-27190# National Aviation Facilities Experimental Center, Atlantic City, N. J.
THERMAL DECOMPOSITION PRODUCTS OF AIRCRAFT INTERIOR MATERIALS Final Report, Jan. - Dec. 1976
Joe C. Spurgeon, Louise C. Speitel, and Ray E. Feher Apr. 1977 53 p refs
(AD-A039511; FAA-NA-76-53; FAA-RD-77-20) Avail: NTIS HC A04/MF A01 CSCL 01/3

Aircraft interior materials were thermally decomposed using a combustion tube furnace. A 250-milligram sample was exposed to a temperature of 600 C for 5 minutes while maintaining an airflow rate of 2 liters per minute through the combustion tube. The combustion products were collected in liquid-filled fritted bubblers, and the contents were analyzed for hydrogen cyanide, hydrogen sulfide, hydrogen chloride, hydrogen bromide, and formaldehyde by differential pulse polarography; nitrogen dioxide and sulfur dioxide by visible spectrophotometry; and hydrogen fluoride by potentiometric titration. Carbon monoxide was collected in plastic sample bags and measured by nondispersive infrared analysis. The yields of the nine gases are reported in terms of milligrams per gram of material. Parametric studies were also conducted to characterize the effects of experimental parameters on gas yields. These parameters include sample weight (250 and 750 mg), percent oxygen (0, 10.5, and 21 percent), airflow rate (1 to 3 lpm), and temperature (400, 600, 800 C). Author

N77-27191*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
REUSABLE SURFACE INSULATION (RSI) MATERIAL SAMPLES Final Report
R. P. Banas 27 Jun. 1977 27 p
(Contract NAS9-14771)
(NASA-CR-151457; LMSC-D575854) Avail: NTIS HC A03/MF A01 CSCL 11D

Test specimen data sheets are presented for 48 high temperature and 40 low temperature reusable surface insulation tiles. Tabular data show dimensions, density, coating weight, and final tile weight. Codes indicate basic material, surface coating, and hydrophobic treatment. A.R.H.

N77-27192# Lockheed-California Co., San Diego.
LOCKALLOY Be-38Al MATERIAL CHARACTERIZATION. THE 1976 YEAR-END REPORT
J. F. Sullivan and A. C. Haramis 10 May 1977 106 p
(LR-28051) Avail: NTIS HC A06/MF A01

The results of a testing program to establish the characteristics of Lockalloy material, a beryllium - aluminum composite, are presented. Tests involved experimental and analytical studies conducted to obtain information regarding basic Be-38Al Lockalloy material properties and characteristics. The studies provided data regarding impact strength, resistance to stress corrosion, response to post-manufacturing thermal treatment, weldability, and inspectability. The accuracy of methods for determining the modulus of elasticity and predicting compression instability (column strength) were also verified. In addition, the behavior of this material in certain structural concepts, considered for the X-24C airplane, was evaluated. Author

N77-27193*# Elmendorf Research, Inc., Palo Alto, Calif.
DEVELOPMENT OF FIRE-RESISTANT WOOD STRUCTURAL PANELS Final Report
Thomas W. Vaughan and Roland Etzold Jul. 1977 42 p refs
(Contract NAS2-9184)
(NASA-CR-152019) Avail: NTIS HC A03/MF A01 CSCL 11G

Structural panels made with Xylok 210 resin as the binder had a burn-through resistance at least equal to the structural panels made with Kerimid 500. Therefore, because of its comparative ease of handling, Xylok 210 was selected as the resin binder to provide the baseline panel for the study of a means of improving the flame-spread resistance of the structural panels. The final resin-filler system consisted of Xylok 210 binder with the addition of ammonium oxalate and ammonium phosphate to the strands of the surface layers, using 24% of each salt based upon the air-dry weight of the strands. This system resulted in a panel with a flame-spread code of about 60, a Class 2 classification. A standard phenolic based structural panel had a flame-spread greater than 200 for laboratory prepared panels. The burn-through tests indicated an average burn-through time of 588 seconds for the specimens made with the final system. This compares to an average burn-through time of 287 seconds for the standard phenolic base structural specimen. One full-size panel was made with the final system. Author

N77-27194# Oak Ridge Y-12 Plant, Tenn. Dept. of Fabrication Systems Development.
COMPOSITE FLYWHEEL DEVELOPMENT Technical Report, 1 May - 30 Jun. 1976
R. L. Huddleston, J. J. Kelly, and C. E. Knight Jan. 1977 26 p refs
(Contract W-7405-eng-26)
(Y-2072) Avail: NTIS HC A03/MF A01

Composite flywheel program objectives and accomplishments for the period from May 1 through June 30, 1976 are summarized. Initial application selected for the development of the composite flywheel is the heat engine flywheel hybrid propulsion system for a vehicle, because of its high potential for the conservation of petroleum fuel in both the near and long range time frames. Efforts focused into key areas consistent with its experience base are: (1) state-of-the-art flywheel development, (2) spin testing, and (3) containment development. An operating performance goal of 20 watt hr/lb (20 Wh/lb) energy density at an energy level of 0.56 kWh was established. The 20 Wh/lb goal encompasses both the composite flywheel and the hub that connects it to the shaft. The goal exceeds the present performance of isotropic flywheels, and is also at the upper limit of current laboratory technology. ERA

N77-27195# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Ground Equipment/Materials Directorate.
REUSABILITY OF FILAMENT-WOUND COMPOSITE LAUNCH TUBES WHEN SUBJECTED TO THE EXHAUST OF ROCKETS USING ALUMINIZED PROPELLANT
G. A. Clodfelter, D. E. Lovelace, and William E. Dick 21 Dec.

1976 104 p refs
(DA Proj. 1W3-62303-A-214)
(AD-A039067; RL-776) Avail: NTIS HC A06/MF A01 CSCL 16/1

It is the intent of this report to initiate the search for material combinations that will permit the repeated use of filament-wound launch tubes with rockets having aluminized propellant. Initial qualitative screening was accomplished, under contract, by the Brunswick Corporation. Further in-house evaluation was performed on tube sections containing selected material combinations resulting from the initial screening process. The use of various material combinations as a basic tube matrix was unproductive. It seems that a liner is essential to the reuse of filament-wound launch tubes. Several liner material combinations for filament-wound tubes are proposed for scaled live-firing tests with motors having aluminized propellant. It is also recommended that qualitative screening be continued for other liner material combinations. Author (GRA)

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N77-27196 Memphis State Univ., Tenn.
DETERMINATION OF SOME RADIONUCLIDES IN ALUMINUM AND NICKEL BY GAMMA SPECTROMETRY Ph.D. Thesis
Pat Sabel Karr 1976 93 p
Avail: Univ. Microfilms Order No. 77-3151

Aluminum and nickel generated from scraps of uranium gaseous diffusion plants are analyzed for concentrations of radioactive contaminants. Gamma radiations at 63 and 93 keV in the U-238 decay chain were used for measurement of U-238 in aluminum but are severely attenuated in nickel. Less than 3.5 ppm U-235 was determined along with a lower limit of 5 ppb of Np-237. Count rates from bremsstrahlung produced by beta particle interactions were used to determine Tc-99 concentrations at an estimated lower level of 100 ppb plus or minus 55 ppb. Dissert. Abstr.

N77-27197 Howard Univ., Washington, D.C.
DIFFERENTIAL ANODIC STRIPPING VOLTAMMETRY AT THE MERCURY FILM ELECTRODE Ph.D. Thesis
Troy James Stewart 1975 154 p
Avail: Univ. Microfilms Order No. 76-30128

The preparation, characterization, and utility of mercury film electrodes (MFE) for the determination of trace metals by differential anodic stripping voltammetric technique were investigated. Mercury systems were studied in the presence of thiocyanate, nitrate, chloride, and perchloris acids and by anodic stripping voltammetry. The later technique verified that mercury films can be made with great efficiency in a thiocyanate medium. The MFE were used to study trace amounts of ions in solutions using the differential anodic stripping voltammetric technique. A study of individual electrodes was made using cadmium, copper chloride, and lead. It is shown that many ions can be determined simultaneously by this process. Dissert. Abstr.

N77-27198 North Carolina Univ., Chapel Hill.
MAGNETIC STUDIES ON INTRACLUSTER AND INTERCLUSTER EXCHANGE IN FIRST ROW TRANSITION METAL COMPLEXES Ph.D. Thesis
Van Hale Crawford 1976 218 p
Avail: Univ. Microfilms Order No. 77-2027

Magnetic properties of several series of transition metal complexes were determined in attempts to determine the nature of intra- and intercluster interactions which are present. Data were collected over wide ranges of temperatures and magnetic field strengths using equipment that was modified or designed for the problems which were undertaken. Special attention was given to characterization of standards which were used to calibrate the experimental apparatus. The compounds HgCo(NCS)4 and [Cu(2,2'-bipyridyl)2 thiourea]CLO4)2 were reevaluated for use as magnetic susceptibility standards, especially at high fields and low temperatures. The Curie-Weiss theta value was found to be -1.86K for HgCo(NCS)4, and the data are best described by a zero-field splitting. The properties of the copper(II) complex were found to be readily understood in terms of a molecular field model. Dissert. Abstr.

N77-27199 Ohio State Univ., Columbus.
SYNTHESES AND CHARACTERIZATION OF CHROMIUM COMPLEXES WITH TETRAAZA MACROCYCLIC LIGANDS Ph.D. Thesis
Robert Charles Edwards 1976 155 p
Avail: Univ. Microfilms Order No. 77-2394

Chromium complexes with dmf, l-methylimidazole, pyridine, thiocyanate, cyanide, phenyl, methyl, and n-butyl ligands were studied. All of these derivatives are sensitive to air and contain six-coordinate high spin chromium(III) ions. Electrochemical results indicate that unusually facile chromium(III) oxidation potentials are responsible for the sensitivity to air displayed by the complexes. The compounds with aryl and alkyl groups are crystalline and contain thermally stable chromium(III)-carbon sigma bonds. Complexes having the chromium ion in the unusual mono- and tetrapositive oxidation states were synthesized and characterized. The reaction of two different chromium macrocyclic ligand complexes with sodium nitrite produced stable five- and six-coordinate chromium(I) nitrosyl complexes which are low spin in nature. The iodine oxidation of an aryl derivative of chromium(III) yields a relatively stable five-coordinate chromium(IV) complex. Dissert. Abstr.

N77-27200 Rensselaer Polytechnic Inst., Troy, N. Y.
MATERIALS FOR A HIGH TEMPERATURE COAL-BASED PROCESS TO PRODUCE ELECTROLYTICALLY PURE HYDROGEN Ph.D. Thesis
Kenneth Walter Browall 1976 190 p
Avail: Univ. Microfilms Order No. 77-2823

A wide variety of materials were synthesized and evaluated including fluorite structure oxides based on both CeO2 and Y2O3-stabilized ZrO2, perovskite related oxides, and Bi2O3-based materials. The results, plus an assessment of materials' stability, indicated that Ce- and Cr- doped Y2/3stabilized ZrO2 are the most promising candidate materials. The two compositions (CeO2)0.041(Y2O3)0.067(ZrO2)0.892 and (Cr2O3)0.081(Y2O3) 0.067 (ZrO2)0.852 were prepared in the form of plasma sprayed sintered tubes. hydrogen production was successfully demonstrated in a reactor system utilizing these tubes. Using counter-current flow CO/CO2 on one side of the material and H2/H2O on the opposite side, hydrogen production was measured as a function of feed gas composition, feed gas flow rate, temperature, and pressure. Preliminary process designs were formulated and the economic feasibility of the process was evaluated. Dissert. Abstr.

N77-27201 Brigham Young Univ., Provo, Utah.
NONAQUEOUS SOLVENT SYSTEMS, INSTRUMENTATION, AND HIGH PRECISION ASSAY IN CONSTANT-CURRENT COULOMETRY Ph.D. Thesis
Michael R. Winward 1976 90 p
Avail: Univ. Microfilms Order No. 77-2180

The electrogeneration of iodide ion from iodine in acetonitrile for use in constant-current coulometric iodometric determinations was studied. Purification of acetonitrile and iodine was found to be necessary. Copper and ceric determinations were not found to be possible by this technique. A charge buret for use in constant-current coulometry is described. It provides manual and automatic control of the current flow and measures the time of current flow to within 0.005%. NBS SRM 136c, potassium dichromate, was assayed by high precision coulometric titration. A differential method of performing high precision coulometric titrations that is much more convenient is described. Ferrous ethylenediammonium sulfate and ferrous ammonium sulfate were assayed by this method. Neither was found to be a primary standard. Dissert. Abstr.

N77-27202 Indiana Univ., Bloomington.
STUDIES IN INORGANIC NUCLEAR MAGNETIC RESO-

NANCE AND THE STRUCTURE OF A METALLOCARBORANE Ph.D. Thesis
Harvey Walter Johnson 1976 188 p
Avail: Univ. Microfilms Order No. 77-1961

A pattern recognition approach to the assignment of the boron -11 nmr spectra of boron hydrides was investigated. Fourier transform natural abundance oxygen -17 nmr is shown to provide results similar to those previously obtained using enriched compounds, but with significant savings in time and effort. A correlation between O -17 chemical shifts and bond order in S - O bonds similar to that observed in Cr compounds is suggested. The contact shifted boron -11 nmr spectra and extended Hueckel molecular orbital calculations are used to reassign the B-11 spectra of metallocarboranes. It is shown that electron delocalization in these compounds can be interpreted as the result of a combination of the exchange polarization and pi delocalization mechanisms. The crystal structure of (C5H5)Fe (B10H10C[O(C2H5)]2) is shown to be of the sandwich type, with the cyclopentadienyl ring and carbollide cage situated in an eclipsed arrangement on opposite sides of the metal atom. Dissert. Abstr.

N77-27203*# Lehigh Univ., Bethlehem, Pa. Center for Surface and Coatings Research.
HETEROGENEOUS CHEMICAL REACTIONS: PREPARATION OF MONODISPERSE LATEXES Final Report
J. W. Vanderhoff, F. J. Micale, M. S. El-Aasser, A. A. Sterk (Gen. Elec. Co., Philadelphia), and G. W. Bethke (Gen. Elec. Co., Philadelphia) 5 Jul. 1977 40 p refs
(Contract NAS8-32399)
(NASA-CR-150333) Avail: NTIS HC A03/MF A01 CSCL 07D

It is demonstrated that a photoinitiated emulsion polymerization can be carried out to a significant conversion in a SPAR rocket prototype polymerization vessel within the six minutes allowed for the experiment. The percentage of conversion was determined by both dilatometry and gravimetric methods with good agreement. The experimental results lead to the following conclusions: (1) emulsion polymerizations can be carried out to conversions as high as 75%, using a stable micellized styrene-SLS system plus photoinitiator; (2) dilatometry can be used to accurately determine both the rate and conversion of polymerization; (3) thermal expansion due to the light source and heat of reaction is small and can be corrected for if necessary; (4) although seeded emulsion polymerizations are unfavorable in photoinitiation, as opposed to chemical initiation, polymerizations can be carried out to at least 15% conversion using 7940A seed particles, with 0.05% solids; and (5) photoinitiation should be used to initiate polymerization in the SPAR rocket experiments because of the mechanical simplicity of the experiment. Author

N77-27204*# Kanner (Leo) Associates, Redwood City, Calif.
STUDY OF THE DESORPTION OF ETHYLENE OXIDE FIXED ON VARIOUS MATERIALS DURING STERILIZATION BY A NEW PROCEDURE
M. Lacomme, M. Chaigneau, and G. LeMoan Washington NASA Jun. 1977 11 p refs Transl. into ENGLISH from Ann. Pharm. Franc. (Paris), v. 35, no. 3/4, 1977 p 91-96
(Contract NASw-2790)
(NASA-TM-75022) Avail: NTIS HC A02/MF A01 CSCL 07D

A continuous sterilization process using ethylene oxide was studied in comparison with a classical method in order to evaluate gas retention as a function of time and temperature on polyethylene, PVC, and rubber materials. Author

N77-27205*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HIGH PRESSURE FLAME SYSTEM FOR POLLUTION STUDIES WITH RESULTS FOR METHANE-AIR DIFFUSION FLAMES
Irvin M. Miller and Howard G. Maahs Jun. 1977 76 p refs
(NASA-TN-D-8407; L-11199) Avail: NTIS HC A05/MF A01 CSCL 21B

A high pressure flame system was designed and constructed for studying nitrogen oxide formation in fuel air combustion. Its advantages and limitations were demonstrated by tests with a confined laminar methane air diffusion flame over the pressure range from 1 to 50 atm. The methane issued from a 3.06 mm diameter port concentrically into a stream of air contained within a 20.5 mm diameter chimney. As the combustion pressure is increased, the flame changes in shape from wide and convex to slender and concave, and there is a marked increase in the amount of luminous carbon. The height of the flame changes only moderately with pressure. Author

N77-27206# California Univ., Berkeley. Lawrence Berkeley Lab. Div. of Energy and Environment.
IDENTIFICATION AND DETERMINATION OF PARTICULATE COMPOUNDS: ELECTRON SPECTROSCOPY
T. Novakov Oct. 1976 48 p refs
(Contract W-7405-eng-48)
(LBL-5290) Avail: NTIS HC A03/MF A01

The application of X-ray photoelectron spectroscopy (ESCA) to the chemical characterization of atmospheric particulates is described. The experimental results reviewed involve the measurement of chemical shift and determination of relative concentrations and physical properties such as thermal stability and volatility of particulate species. The application of multiplet splitting to the determination of oxidation states of certain transition metals is also described. The use of photoelectron spectroscopy has helped to uncover several previously unsuspected chemical species associated with particulates and to provide the first information about their surface composition. ERA

N77-27207# Pittsburgh Univ., Pa. Dept. of Chemistry.
MICROWAVE-OPTICAL DOUBLE RESONANCE SPECTROSCOPY Progress Report, 1 Feb. 1976 - 31 Jan. 1977
D. W. Pratt 1 Nov. 1976 26 p refs
(Contract E(11-1)-3435)
(COO-3435-27) Avail: NTIS HC A03/MF A01

Zero field and high field optical detection of magnetic resonance (ODMR), electron paramagnetic resonance (EPR), and optical spectroscopy experiments were performed on several systems in order to further basic knowledge of the structure, reactions, and response to radiation of atoms, molecules, and ions in their ground and/or excited electronic states. A wide variety of systems, ranging from biological molecules containing transition metal ions to small free radicals containing only three or four atoms, was investigated. Treatments of the fundamental equations of quantum mechanics which govern the behavior of paramagnetic systems in the solid state were extended. The motion of mobile excitations in organic crystals at low temperatures was studied. A paramagnetic resonance without microwaves technique was developed for obtaining information about cross relaxation behavior involving two different spin systems in contact with the same thermal reservoir. ERA

N77-27208# Boston Univ., Mass. Dept. of Chemistry.
THE TEMPERATURE DEPENDENCE OF TRIPLET STATE REACTION RATE AND QUANTUM YIELD FOR AN INTRAMOLECULAR ENONE PHOTOCYCLOADDITION Technical Report, 1 May - 31 Oct. 1975
Guilford Jones, II and Bellampalli R. Ramachandran 1 Dec. 1976 8 p refs Submitted for publication Sponsored in part by the Petroleum Research Fund
(Contract N00014-67-A-0280-0003; ARPA Order 2721)
(AD-A034156) Avail: NTIS HC A02/MF A01 CSCL 07/3

Valence photoisomerization '320-380 NM' of endo-tricyclodeca-4, 8-diene-3-one has been studied as a function of temperature. At 4 - 51 the isomerization quantum yield is independent of temperature. In the same range the lifetime for the triplet state responsible for isomerization decreases. Arrhenius parameters for triplet decay are computed. A mechanism involving formation of a diradical intermediate which partitions to the valence isomers is suggested. GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N77-27209 Illinois Univ., Chicago.
INVESTIGATION OF THE MAGNETISM AND STRUCTURE OF SELECTED TRANSITION METAL COMPLEXES

Ph.D. Thesis
Charles Joseph Connor, Jr. 1976 210 p
Avail: Univ. Microfilms Order No. 77-2845

Transition metal compounds are examined with an emphasis on correlating magnetic and crystal field properties with structure. Much of the work is done at liquid helium temperatures because observation of the ground state is unobstructed by populated excited states. Experiments performed on these compounds are: electron paramagnetic resonance (EPR) at 300, 77, and 4.2 K, using X- and Q-band; magnetic susceptibilities, measured at near zero field using the Hartshorn bridge technique, in the 1.5 to 30 K temperature region; and specific heat measurements, using the heat pulse technique, in the 0.9 to 40 K temperature region. All experiments are performed on single crystals and much of the data analysis is supported by precession camera photographs utilizing X-rays for orientation and unit cell determinations. Dissert. Abstr.

N77-27210 Case Western Reserve Univ., Cleveland, Ohio.
INFLUENCE OF GRAIN REFINEMENT ON THE STRUCTURE AND PROPERTIES OF CAST NICKEL-BASE SUPERALLOYS Ph.D. Thesis
Allen Frederick Denzine 1976 216 p
Avail: Univ. Microfilms Order No. 76-28384

The T-63 rotor, used in a turbine powered helicopter, was chosen for study, and investment molds were designed to simulate the solidification conditions of the hub and rim sections of the rotor. Three nickel base superalloys, 713 LC, MAR-M 246, and C 103, were selected for casting as they represent a suitable cross-section of the materials used in the application. Dissert. Abstr.

N77-27211*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
CONTAINERLESS PROCESSING OF BERYLLIUM Final Report
Gerald Wouch, George H. Keith, Robert T. Frost, and Norman P. Pinto Jun. 1977 65 p refs
(Contract NAS8-31963)
(NASA-CR-150142) Avail: NTIS HC A04/MF A01 CSCL 11F

Melting and solidification of a beryllium alloy containing 1.5% BeO by weight in the weightless environment of space has produced cast beryllium with a relatively uniform dispersion of BeO throughout. Examination of the cast material shows that it is coarse grained, although the BeO is not heavily agglomerated in the flight specimen. Ground based comparison experiments show extreme agglomeration and segregation of BeO, resulting in large zones which are practically free of the oxide. Several postulated hypotheses for the failure to grain refine the beryllium are formulated. These are: (1) spherodization of the BeO particles during specimen preparation and during the molten phase of the experiment; (2) loss of nucleation potency through aging in the molten phase; and (3) inability of BeO to act as a grain refiner for beryllium. Further investigation with non spherodized particles and shorter dwell times molten may delineate which of these hypotheses are valid. The results of this flight experiment indicate that the weightless environment of space is an important asset in conducting research to find grain refiners for beryllium and other metals for which cast dispersions of grain refining agents cannot be prepared terrestrially due to gravitationally driven settling and agglomeration. Author

N77-27212*# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
EFFECTS OF GRAVITY REDUCTION ON PHASE EQUILIBRIA. PART 1: UNARY AND BINARY ISOSTRUCTURAL SOLIDS
D. J. Larson, Jr. Sep. 1975 48 p refs
(Contract NAS8-28728)
(NASA-CR-150315; RM-608-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 11F

Analysis of the Skylab II M553 Experiment samples resulted in the hypothesis that the reduced gravity environment was altering the melting and solidification reactions. A theoretical study was conducted to define the conditions under which such alteration of phase relations is feasible, determine whether it is restricted to space processing, and, if so, ascertain which alloy systems or phase reactions are most likely to demonstrate such effects. Phase equilibria of unary and binary systems with a single solid phase (unary and isomorphous) were considered. Author

N77-27213*# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
EFFECTS OF GRAVITY REDUCTION ON PHASE EQUILIBRIA. PART 2: BINARY TWO-PHASE SOLIDS
D. J. Larson, Jr. Jul. 1976 37 p refs
(NASA-CR-150316; RM-622-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 11F

Phase diagrams for two-phase solids and eutectic, monotectic, peritectic, and syntectic reactions in low gravity applications to processes and products are considered. Author

N77-27214*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THEORETICAL AND EXPERIMENTAL STUDIES OF THE DEPOSITION OF Na2SO4 FROM SEEDED COMBUSTION GASES
Fred J. Kohl, Gilbert J. Santoro, Carl A. Stearns, George C. Fryburg, and Daniel E. Rosner (Yale Univ.) 13 May 1977 29 p refs Presented at the Symp. on Corrosion Probl..Involving Volatile Corrosion Prod., Philadelphia, 8-13 May 1977; sponsored by the Electrochemical Society
(NASA-TM-X-73683; E-9031) Avail: NTIS HC A03/MF A01 CSCL 21E

Flames in a Mach 0.3 atmospheric pressure laboratory burner rig were doped with sea salt, NaSO4, and NaCl, respectively, in an effort to validate theoretical dew point predictions made by a local thermochemical equilibrium (LTCE) method of predicting condensation temperatures of sodium sulfate in flame environments. Deposits were collected on cylindrical platinum targets placed in the combustion products, and the deposition was studied as a function of collector temperature. Experimental deposition onset temperatures checked within experimental error with LTCE-predicted temperatures. A multicomponent mass transfer equation was developed to predict the rate of deposition of Na2SO4(c) via vapor transport at temperatures below the deposition onset temperature. Agreement between maximum deposition rates predicted by this chemically frozen boundary layer (CFBL) theory and those obtained in the seeded laboratory burner experiments is good. Author

N77-27215*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HOT CORROSION RESISTANCE OF NICKEL-CHROMIUM-ALUMINUM ALLOYS
Gilbert J. Santoro and Charles A. Barrett May 1977 35 p refs Presented at the 151st Meeting of the Electrochem. Soc., Philadelphia, 8-13 May 1977
(NASA-TM-73664) Avail: NTIS HC A03/MF A01 CSCL 11F

The hot corrosion resistance of nickel-chromium-aluminum alloy was examined by cyclically oxidizing sodium sulfate coated specimens in still air at 900, 1000 and 1100 C. The compositions tested were within the ternary region: Ni; Ni-50 at.% Cr; and Ni-50 at.% Al. At each temperature the corrosion data were statistically fitted to a third order regression equation as a function of chromium and aluminum contents. Corrosion isopleths were prepared from these equations. Compositional regions with the best hot corrosion resistance were identified. Author

N77-27216# Berkeley Scientific Translation Service, Calif.
INVESTIGATION OF MUTUAL DIFFUSION IN THE Nb-Ge-Al SYSTEM
G. N. Ronami and V. P. Berezina Oct. 1976 9 p refs Transl. into ENGLISH from Struktura i Svoistva Sverkhprovodyashchikh Mater. Izdatel'stvo Nauka (Moscow), 1974 p 25-29 Sponsored by ERDA Prepared for Calif. Univ., Berkeley. Lawrence Berkeley Lab.
(UCRL-Trans-1534) Avail: NTIS HC A02/MF A01

Phase diagrams of the Nb-Ge and Nb-Al systems are presented. In order to produce diffusion layers of the ternary system Nb-Ge-Al, an Al-Ge mixture was placed in a niobium vessel whose mouth was plugged with a ground glass niobium stopper, and the samples then were subjected to diffusion annealing at temperatures of 1600 and 1700 C with subsequent quenching in an argon atmosphere. The concentration curves

from an analysis of these diffusion layers are presented and discussed. The superconducting transition temperature was measured inductively. ERA

N77-27217# Ames Lab., Iowa.
ELECTROMIGRATION AS A PURIFICATION PROCESS
D. T. Peterson 1976 27 p refs Presented at AIME Fall Meeting, Niagara Falls, N. Y., 20 Sep. 1976
(Contract W-7405-eng-82)
(IS-M-87; Conf-7609106-1) Avail: NTIS HC A03/MF A01

Purification of metals and alloys by electromigration has certain inherent advantages and some limitations. A very high degree of purification with regard to both substitutional and interstitial impurities can in some cases be achieved. In solid metals, it is quite simple and easily controlled. In the case of liquid metals, it is necessary to prevent fluid flow and mixing in order to achieve purification. Prediction of the degree of purification which can be achieved on the basis of an ideal isothermal system is discussed. Calculation of the time required to reach the steady-state condition is shown. The effects of temperature gradients, impurity transfer to and from the electrodes, environmental contamination, and solute precipitation are examined. Some examples of successful application of the method are cited, and possible avenues for future development are indicated. ERA

N77-27218# Oak Ridge National Lab., Tenn.
PROPERTIES OF TYPE 1811 CrNi STAINLESS STEEL AND PARENT-LIKE WELD JOINTS AS RELATED TO HIGH-TEMPERATURE APPLICATION
E. D. Grosser, E. TeHeesen, and H. Lorenz 1974 14 p refs Transl. into ENGLISH from West German Report AED-CONF-74-538-008 Presented at 2d Symp. on Welding in Nucl. Eng., Dusseldorf, West Ger., 23-24 Oct. 1974 Sponsored by ERDA
(ORNL-TR-4034; Conf-741092-1; AED-CONF-74-538-008) Avail: NTIS HC A02/MF A01

With X 6 CrNi 1811 steel, an unstabilized austenitic steel for use at high temperatures was introduced. In application this steel has confirmed the good results obtained abroad with the comparable AISI 304 with respect to machining, welding behavior with the use of weld metal of the same type, and long- and short-term mechanical characteristics. The differences in mechanical behavior of the base metal and the welded joints due to the low content of delta-ferrite and the structure of the weld metal must be considered in special applications. The adoption in Germany of American design specifications for the high temperature range for the base metal and especially for the welded joints makes further studies necessary on fatigue behavior and related problems. ERA

N77-27219# Oak Ridge National Lab., Tenn.
LOW CYCLE FATIGUE STRENGTH OF SOME AUSTENITIC STAINLESS STEELS AT ROOM TEMPERATURE AND ELEVATED TEMPERATURES
Mar. 1975 44 p refs Transl. into ENGLISH from Japanese Report JAERI-1237
(ORNL-TR-4285; JAERI-1237) Avail: NTIS HC A03/MF A01

Type 304, 316, and 316L stainless steels were tested from room temperature to 650 C using two kinds of bending test specimens. Particularly, Type 304 was tested at several cyclic rates and 550 and 650 C, and the effect of cyclic rate on its fatigue strength was investigated. Test results are summarized as follows: (1) the bending fatigue strength at room temperature test shows good agreement with the axial fatigue one; (2) Manson-Coffin's fatigue equation can be applied to the results; (3) the ratio of crack initiation to failure life becomes larger at higher stress level; and (4) the relation between crack propagation life and total strain range or elastic strain range is linear in log-log scale. It was also observed at the elevated temperature test: (1) the reduction of fatigue strength is not noticeable below 500 C, but it is noted at higher temperature; (2) the cycle rate does not affect fatigue strength in faster cyclic rate than 20 cpm and below 100,000 cycles life range; and (3) Type 316 stainless steel shows better fatigue property than type 304 and 316L stainless steels. ERA

N77-27220# Oak Ridge Y-12 Plant, Tenn.
EFFECTS OF ORIENTATION ON THE ROLLING AND RECRYSTALLIZATION BEHAVIOR OF TANTALUM SINGLE CRYSTALS Ph.D. Thesis - Tenn. Univ., Knoxville
W. B. Snyder, Jr. Dec. 1976 118 p refs
(Contract W-7405-eng-26)
(Y-2062) Avail: NTIS HC A06/MF A01

Tantalum single crystals were rolled unidirectionally at room temperature to a thickness reduction of 80 percent. Optical and electron metallography, X-ray line broadening and pole figure analyses, and microhardness testing were used to study the deformed, recovered, and recrystallized structures of these crystals. Crystal stability, reorientation, and deformation banding was interpreted in terms of the Taylor theory of plasticity as applied to pencil glide in body-centered-cubic metals. Experimental results were in partial agreement with the theory. Nucleation of recrystallization was found to occur by the polygonization and growth of dislocation cells originally present in the deformed structure. Impingement of these growing nuclei resulted in a fully recrystallized structure whose orientations were present in the deformed crystal. ERA

N77-27221# Argonne National Lab., Ill.
JOINING NbTi SUPERCONDUCTORS BY ULTRASONIC WELDING
J. W. Hafstrom, D. H. Killpatrick, R. C. Niemann, J. R. Purcell, and H. R. Thresh 1976 4 p Presented at Appl. Superconductivity Conf., Stanford, Calif., 16-20 Aug. 1976
(Contract W-31-109-eng-38)
(CONF-760829-50) Avail: NTIS HC A02/MF A01

A process for joining NbTi, copper stabilized, superconducting composites by ultrasonic welding is described. This process yields a joint strength comparable to that of the superconducting composite and a resistivity significantly lower than achieved by conventional soft soldering. The superconducting properties of the composite are not affected by the joining process. Scarfing the joint to maintain a constant conductor cross section does not degrade its electrical or mechanical properties. The application of the ultrasonic joining process, including process control, scarfing, and NDT procedures, in the construction of the superconducting magnet is described. ERA

N77-27222# Argonne National Lab., Ill.
STATISTICAL ANALYSIS OF ELEVATED-TEMPERATURE, STRAIN-CONTROLLED FATIGUE DATA ON TYPE 304 STAINLESS STEEL
D. R. Diercks and D. T. Raske 1976 35 p refs Presented at the ASME Ann. Winter Meeting, New York, 5-10 Dec. 1976
(Contract W-31-109-eng-38)
(CONF-761107-20) Avail: NTIS HC A03/MF A01

The available elevated temperature, strain controlled, uniaxial fatigue data on Type 304 stainless steel (435 data points) are summarized, and variables that influence cyclic life are divided into first- and second-order categories. The first-order variables, which include strain range, strain rate, temperature, and tensile hold time, were used in a multivariable regression analysis to describe the observed variation in fatigue life. Goodness of fit with respect to these variables as well as the appropriateness of the transformations employed are discussed. Confidence intervals are estimated, and a comparison with the ASME Boiler and Pressure Vessel Code Case 1592 creep-fatigue design curve is made for a particular set of conditions. The second-order variables include the laboratories at which the data were generated, the different heats from which the test specimens were fabricated, and the heat treatments that preceded testing. These variables were statistically analyzed to determine their effect on fatigue life. ERA

N77-27223# Atomics International, Golden, Colo.
HARDNESS SURVEY OF COLD-WORKED AND HEAT-TREATED JBK-75 STAINLESS STEEL ALLOY
Ross J. Jackson and R. L. Lucas 24 Jan. 1977 15 p refs
(Contract EY-76-C-04-3533)
(RFP-2492) Avail: NTIS HC A02/MF A01

The alloy JBK-75, an age hardenable austenitic stainless steel, is similar to commercial A-286, but has certain chemistry modifications to improve weldability and hydrogen compatibility. The principal changes are an increase in nickel and a decrease in manganese with lower limits on carbon, phosphorus, sulfur, silicon, and boron. The effects of solutionizing time and temperature, quench rate, cold working, and the effects of cold working

on precipitation kinetics were examined. Findings show that the solutionizing temperature has a moderate effect on the as-quenched hardness, while times greater than that required for solutionizing do not significantly affect hardness. Quench rate was found to have a small effect on as-quenched hardness; however, hardness gradients did not develop in small bars. It was found that JBK-75 can be significantly strengthened by cold working. ERA

N77-27224# California Univ., Berkeley. Lawrence Berkeley Lab.
EFFECTS OF THE TRIP PHENOMENON ON THE TOUGHNESS OF HEAT TREATABLE ALLOY STEELS
Gabriel Kohn 10 Nov. 1976 136 p refs
(Contract W-7405-eng-48)
(LBL-5466) Avail: NTIS HC A07/MF A01

It is shown that substantial amounts of untransformed austenite can be obtained in low alloy steels by a combination of alloy modification (addition of silicon) and heat treatment. In silicon modified AISI 4330 steel, the amount of untransformed austenite is varied by utilizing isothermal treatments both above and below the M/sub s/. The stability of the untransformed austenite is found to be dependent on the amount of silicon and also on the tempering temperature. A magnetic saturation technique was utilized to monitor the transformation of the austenite under uniaxial tensile loading. An improvement in the plane strain fracture toughness (K/sub Ic/) was observed when the retained austenite transformed with respect to strain. The improvement was optimized with particular combinations of stability and volume fractions of retained austenite. The addition of silicon resulted in an increase of both the strength and the fracture toughness of the quenched and tempered AISI 4330 steel. ERA

N77-27225# United Nuclear Industries, Inc., Richland, Wash.
CHARACTERIZATION OF LITHIUM-ALUMINATE POWDERS IN J.O. 909 AND J.O. 911
W. E. Gurwell 2 Sep. 1966 19 p refs
(Contract E(45-1)-1857)
(RL-GEN-1142(W/Del)) Avail: NTIS HC A02/MF A01

It is concluded from the combined data that all powders of low bulk density were made from unusual aluminum oxide powder, with smaller particle size and somewhat different impurity content. Microstructure of the low bulk density powders reveals agglomerates having a spongy appearance. High bulk density powders have solid particles. Fisher Subsieve analysis confirms the open porosity of the low bulk density powder agglomerates. There was a rough correlation between raw powder bulk density and alpha-LiAlO2 content. Total carbon content ran from 173 to 1,363 ppM lower than the 3,000 ppM level of the PT 66 powders. Batch weights varied between 330 and 562 pounds, with no visible correlation to powder characteristics. Total Li content was generally held to within 0.3 percent of 10.0. An overall average vendor performance was 9.99 percent Li (21 powder batches, analyses from vendor and Battelle averaged). ERA

N77-27226# Northwestern Univ., Evanston, Ill.
EFFECT OF POINT DEFECTS ON MECHANICAL PROPERTIES OF METALS Technical Progress Report, 1 Jan. - 31 Dec. 1976
M. Meshii Dec. 1976 11 p refs
(Contract EY-76-S-02-1367)
(COO-1367-80) Avail: NTIS HC A02/MF A01

The following topics were studied; (1) Surface Film Softening, (2) Electron Irradiation Softening of Iron, (3) Comparative Study of Two Softening Phenomena, (4) Preparation and Plastic Deformation of Niobium Sheet Single Crystals, and (5) Dislocation Motion in Copper. ERA

N77-27227# Drexel Univ., Philadelphia, Pa. Dept. of Materials Engineering.
THE FRACTURE OF WROUGHT METALS Final Report, 1 Jul. 1972 - 31 Oct. 1976
William L. Brenneman and Harry C. Rogers 1 Feb. 1977 12 p refs
(Grants DA-ARO-D-31-124-72-G203; DAHC04-74-G-0227)
(AD-A037084; ARO-10155.1-MC) Avail: NTIS HC A02/MF A01 CSCL 11/6

The mechanism of prestrain embrittlement in wrought metals was examined in three alloy systems: Armco iron, 7075-T651 aluminum, and a copper-SiO2 alloy. Specimens were compressively prestrained, then tested in tension in and transverse to the direction of compression. Prestrain embrittlement was observed in all three alloys, depending on test conditions. In the copper-base alloy, which was in the form of thin sheet, the retained tensile ductility was reduced linearly by inplane compressive prestrain. Fracture was initiated by crystallographically-oriented voids generated at particle-matrix interfaces during compression. The behavior of Armco iron was similar in that particle-matrix void nucleation during compression provides fracture initiation sites that lead to brittle cleavage failure at room temperature during subsequent notch tensile testing. Prestrain had little influence on smooth bar tensile test results. Crystallographic texture development was shown to play a part in the embrittlement but tests under high pressure that suppressed void nucleation showed the role of texture to be secondary. Prestrain embrittlement in the aluminum alloy results from the interaction of intense shear bands, formed by sufficient compressive prestrain, with the grain boundaries to give a partially intergranular fracture. Author (GRA)

N77-27228# Army Construction Engineering Research Lab., Champaign, Ill.
THE EFFECTS OF BASE METAL NOTCH ORIENTATION AND ACUITY AND WELD POROSITY ON THE DYNAMIC TEAR TOUGHNESS OF A514F STEEL Final Report
E. P. Cox Feb. 1977 33 p refs
(DA Proj. 4A0-78012-A-0-K1)
(AD-A037046; CERL-TR-M-201) Avail: NTIS HC A03/MF A01 CSCL 13/8

The effects of weld porosity on the dynamic tear properties of A514F steel butt welds were assessed in a program which conducted dynamic tear tests in six areas of experimentation: (1) the base plate steel in the longitudinal and transverse orientations; (2) sound weld metal; (3) weld metal containing clustered porosity; (4) weld metal containing linear porosity; (5) stress-relieved weld metal; and (6) base metal in the longitudinal and transverse directions having fatigue precracked notches. The upper shelf dynamic tear toughness of the base plate was observed to be much greater for specimens with the notch oriented perpendicular to the final rolling direction than for the specimens with the notch parallel to the final specimens which had notches precracked in fatigue and oriented parallel to the rolling direction had the same toughness-temperature behavior as specimens that were machine-notched in the same orientation. The toughness values of the fatigue precracked specimens whose notches were perpendicular to the rolling direction were greater than for the same orientation specimens with machined notches. The fatigue precracked specimens had higher temperature ductile-to-brittle transitions than the machine-notched specimens. Weld specimens had upper shelf toughness values which were less than the toughness values of base plate specimens that were notched perpendicular to their rolling direction; however, these values were greater than the toughness values of base plate specimens notched parallel to the rolling direction. Both the clustered porosity and the linear porosity specimens had toughness values somewhat lower than the sound weld specimens. GRA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N77-27229*# Scientific Translation Service, Santa Barbara, Calif.
PROCESS FOR THE MANUFACTURE OF POLYMERS IN BEADS
Washington NASA May 1977 10 p Transl. into ENGLISH from French Patent no. 1462456 (Appl. no. F27357 IV b-39c, 24 Dec. 1958) 4 p
(Contract NASw-2791)
(NASA-TT-F-17534) Avail: NTIS HC A02/MF A01 CSCL 11G

Bead polymers polymerized from organic compounds where the monomer is combined in water soluble polyalkylene oxides as emulsifiers are described. Author

N77-27230*# DeBell and Richardson, Inc., Enfield, Conn.
STUDY OF COATINGS FOR IMPROVED FIRE AND DECAY RESISTANCE OF MINE TIMBERS Final Report, Dec. 1975 - May 1977
Bernard Baum May 1977 88 p
(Contract NAS2-9077)
(NASA-CR-152009) Avail: NTIS HC A05/MF 01 CSCL 11G

The purpose of this program was to find a fire- and rot-retardant polymer/fungicide reaction product for coating mine timbers. Fire-retardant polymers were screened as films and coatings on fir wood. Curable polyimide appeared to be flame retardant and evolved a minimum of fumes when exposed to a flame. Several organic and metal, low toxicity, fungicides were reacted with the polyimide in-situ on the wood. These coated samples were screened for fungus resistance. All formulations rated well - even the polyimide film without additives was fungicidal. The fir wood control itself resisted internal damage during the ten weeks of fungus exposure. A more severe test for fungus resistance will be required. Author

N77-27231*# United Technologies Research Center, East Hartford, Conn.
GRAPHITE FIBER REINFORCED THERMOPLASTIC RESINS Final Report
Richard C. Navak 18 Apr. 1977 74 p refs
(Contract NAS3-20077)
(NASA-CR-135196; R77-912506-14) Avail: NTIS HC A04/MF A01 CSCL 11G

The results of a program designed to optimize the fabrication procedures for graphite thermoplastic composites are described. The properties of the composites as a function of temperature were measured and graphite thermoplastic fan exit guide vanes were fabricated and tested. Three thermoplastics were included in the investigation: polysulfone, polyethersulfone, and polyarylsulfone. Type HMS graphite was used as the reinforcement. Bending fatigue tests of HMS graphite/polyethersulfone demonstrated a gradual shear failure mode which resulted in a loss of stiffness in the specimens. Preliminary curves were generated to show the loss in stiffness as a function of stress and number of cycles. Fan exit guide vanes of HMS graphite polyethersulfone were satisfactorily fabricated in the final phase of the program. These were found to have stiffness and better fatigue behavior than graphite epoxy vanes which were formerly bill of material. Author

N77-27232*# Doweave (N. F.), Inc., King of Prussia, Pa.
DEVELOPMENT OF A TRIAXIALLY FORMED FABRIC FOR USE IN AN IMPROVED RESTRAINT LAYER IN THE SHUTTLE SPACE SUIT Final Report
7 Jul. 1977 18 p
(Contract NAS9-14777)
(NASA-CR-151464; NFD-76D1006; NFD-77D1013) Avail: NTIS HC A02/MF A01 CSCL 11E

A series of materials for use as an improved restraint layer in the shuttle space suit was developed. The feasibility of weaving triaxial fabrics in tight, low porosity configurations with yarns of appropriate sizes and materials was demonstrated along with the stability and isotropy of triaxial fabrics. The triaxial fabric constructions, BP44P and BP40M, can be reproduced on a production basis. Both fabric constructions afford excellent strength-to-weight ratio and exhibit improved tear strength and shear resistance over biaxial fabrics. Author

N77-27233# Phoenix Chemical Lab., Inc., Chicago, Ill.
CHEMICAL AND PHYSICAL PROPERTIES OF LUBRICANTS AND HYDRAULIC FLUIDS Final Report, 1 Apr. 1973 - 31 Mar. 1976
A. A. Krawetz, G. A. Krawetz, and T. Tovrog Wright Patterson AFB, Ohio AFML Jun. 1976 349 p refs
(Contract F33615-73-C-5103)
(AD-A037299; AFML-TR-76-166) Avail: NTIS HC A15/MF A01 CSCL 11/8

The method for the determination of the linear flame propagation rates of lubricants and hydraulic fluids has been studied further and has been applied to a variety of samples. A new method for the evaluation of the ignition of organic liquids by hot surfaces has been developed. Data have been obtained for a variety of different samples. The measurement of oxygen absorption rates has been used for the study of the oxidative stabilities of experimental lubricants and hydraulic fluids both in the presence and in the absence of metal catalysts. The chemical and physical properties of various lubricants and hydraulic fluids have been studied. Special emphasis has been directed toward the investigation of properties relevant to the performance of lubricants and hydraulic fluids under conditions of thermal and oxidative stress. Author (GRA)

N77-27234# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanical Engineering.
MEASUREMENT OF PROPERTIES AND RESPONSE FUNCTIONS OF LIQUID LUBRICANTS RELATED TO TRANSIENT VISCOELASTIC REGIMES Final Report, 1 Apr. 1975 - 31 Mar. 1976
Meyer H. Birnboim 1 Aug. 1976 75 p refs
(Contract F33615-75-C-5105; AF Proj. 7342)
(AD-A037183; AFML-TR-76-146) Avail: NTIS HC A04/MF A01 CSCL 11/8

This report is concerned with measurements of the viscoelastic response functions over a wide range of frequency and pressure that are required for the mechanical characterization of lubricating oils. Both rheo-optical (light scattering) and mechanical (ultrasonic) methods are required to obtain the viscoelastic data. Several developmental aspects of the implementation of these techniques as well as some of the results are discussed herein. GRA

N77-27235# Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Engineering.
THE WEAR OF POLYMERS BY TRANSFERRED FILMS Final Report, 1 Sep. 1973 - 30 Nov. 1976
Norman S. Eiss, Jr. 15 Jan. 1977 106 p refs
(Grants DA-ARO-D-31-124-73-G170; DAHC04-75-G-0008; DAAG29-76-G-0009)
(AD-A037104; ARO-11229.3-E) Avail: NTIS HC A06/MF A01 CSCL 11/9

A wear measuring technique was developed using radioactive tracers. The technique was capable of detecting less than 1 microgram of polymer transferred to a steel surface. The technique was used to measure the wear of PCTFE and PVC in sliding experiments at sliding speeds of less than 1 cm/sec by detecting the CL38 isotope which had been made radioactive by neutron bombardment. Low density polyethylene was doped with one percent Dy 203, and the wear measured by tracing the DY isotope. Scanning electron microscope observations of the wear process showed that transfer of polymer occurred at the highest asperities on the steel surface. The transferred polymer had sheared off at an angle and the shear angles were significantly different for different polymers. The amount of polymer transfer for repeated passes over the same surface was shown to be a function of the angle that the sliding direction made with the lay on the surface. The amount of transfer was least when sliding parallel to the lay, intermediate when sliding perpendicular to the lay, and highest at angles between 10 and 80 deg. The highest wear resulted from transferred polymer being continually moved to the edge of the wear track on subsequent passes. Wear models were proposed for full penetration of the steel surface into the polymer pin (apparent and real areas approximately equal) and partial penetration (apparent area larger than real area). While the model could predict the relative wear of PVC and PCTFE, it predicted that asperity slopes necessary to cause shear stresses high enough for polymer fracture were larger than those measured on the surfaces. The partial penetration model was based on penetration depth and shear angle. GRA

N77-27236# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
IMPACT RESISTANCE OF STRUCTURAL CERAMICS. PART 2: BALLISTIC TESTS Final Report, Jun. 1975 - Feb. 1976
James M. Wimmer, I. Bransky, and Norman M. Tallan Dec. 1976 42 p refs
(AF Proj. 7021)
(AD-A037165; AFML-TR-76-56-Pt-2) Avail: NTIS

HC A03/MF A01 CSCL 11/2

Two mechanisms can lead to failure of ceramics under impact: (1) failure due to flexural stresses, and (2) failure due to Hertzian type cracks introduced locally by the impactor. These mechanisms have been studied in silicon nitride, silicon carbide, and aluminum oxide ceramics using 200-1,000 f/s BB ball steel impactors and different types of specimen support. The critical velocities for flexural failure and Hertzian damage of 1 x 1 x 0.2 inch plates were determined. Author (GRA)

N77-27237# National Bureau of Standards, Washington, D. C. Center for Fire Research.

REPRODUCIBILITY OF THE RADIANT PANEL TEST METHOD (ASTM E 162-67) USING POLYURETHANE FOAM, NEOPRENE, AND HARDBOARD SPECIMENS Final Report

T. G. Lee Mar. 1977 41 p refs

(PB-265089/3; NBSIR-77-1222) Avail: NTIS HC A03/MF A01 CSCL 11I

Interlaboratory evaluation of the radiant panel method for flame spread testing of two flexible foam and one hardboard specimens was made. Results obtained by 13 laboratories, based on 4 replicate tests, showed that the between lab coefficient of variation on the flame spread index (Is) was 21% for Hardboard A, 35% for Urethane B and 45% for Neoprene C. The within-lab coefficient of variation for the Hardboard was 9.9%. The higher variability of results for the foam materials was caused by the rapid melting of the Urethane B and unstable flame front of the Neoprene C specimens during the tests. GRA

N77-27238# Dayton Univ. Research Inst., Ohio.

INFERRING A RELIABLE MECHANICAL STRESS RELAXATION SPECTRUM VIA A REGULARIZATION-QUADRATIC PROGRAMMING TECHNIQUE Final Report, 1 Feb. - 1 Sep. 1976

D. R. Wiff Dec. 1976 21 p refs

(Contract F33615-75-C-5095)

(AD-A038653; AFML-TR-76-238) Avail: NTIS HC A02/MF A01 CSCL 20/11

A reliable technique to aid in the prediction of bulk polymer long term mechanical properties is discussed. This technique - regularization and quadratic programming - is applied to the standard NBS isobutylene Master Curve data of Tobolsky and Catsiff. The results show excellent agreement between the mechanical relaxation spectra achieved when no a priori functional form and the published wedge-box functional form are assumed. Author (GRA)

N77-27239# Army Materials and Mechanics Research Center, Watertown, Mass. Organic Materials Lab.

PIEZOELECTRIC POLYMER FILMS FOR APPLICATION IN MONITORING DEVICES Final Report

Richard J. Shuford Feb. 1977 22 p refs Presented at 1976 Army Sci. Conf., West Point, N. Y., Jun. 1976

(DA Proj. 1T1-63102-D-071)

(AD-A039090; AMMRC-TR-77-2) Avail: NTIS HC A02/MF A01 CSCL 20/3

To develop Army applications based on the pronounced piezoelectric effect noted for polyvinylidene fluoride (PVF2), this laboratory has conducted a systematic investigation of factors responsible for this remarkable behavior of an organic polymer. Commercial PVF2 homopolymer and copolymer films were oriented by uniaxial stretching, biaxial stretching, or rolling. The oriented films were characterized by means of infrared spectroscopy, density, birefringence, sonic modulus, and X-ray diffraction. The oriented films were then poled at various electric field strengths and temperatures for various times. Trends have been noted between draw ratio and the resulting physical properties; the piezoelectric activity has been correlated with draw ratio and poling conditions. The piezoelectric activity has also been investigated after accelerated temperature aging and isothermal aging. Prototype devices have been fabricated at AMMRC with these films to demonstrate their potential utility in microphones, vibration sensors, and strain gages. Further development efforts have been conducted jointly with industrial firms to produce more refined prototype devices, including a remarkable medical sensor. It is concluded that piezoelectric polymer films can provide unique and advantageous solutions to a number of Army problems requiring monitoring and communication devices. Author (GRA)

N77-27240# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Renewable Resources for Industrial Materials.

FIBERS AS RENEWABLE RESOURCES FOR INDUSTRIAL MATERIALS

James S. Bethel 1976 271 p refs

(Grant NSF STP-75-01069)

(PB-264561/2; NSF/PRA-7501069/7/7) Avail: NTIS HC A12/MF A01 CSCL 02C

An introduction to the pulp, paper and paper board industry is presented, as well as an assessment of the industry and the following items: (1) factors affecting the industry, (2) enhancement of availability and utility of materials with reduction in costs, (3) an overview of product substitution, (4) identification of educational roles and needs, and (5) recommended research, costs, returns and time schedules. Other resources for industrial materials were mentioned such as plant fibers other than wood and cotton; in the textile industry: (1) cotton, (2) wool, (3) mohair, (4) synthetic fibers, and (5) furs and leathers. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N77-27241*# Boeing Commercial Airplane Co., Seattle, Wash.

PRELIMINARY ANALYSIS OF AIRCRAFT FUEL SYSTEMS FOR USE WITH BROADENED SPECIFICATION JET FUELS Final Report

A. J. Pasion and I. Thomas Jun. 1977 82 p refs

(Contract NAS3-19783)

(NASA-CR-135198; D6-44538) Avail: NTIS HC A05/MF A01 CSCL 21D

An analytical study was conducted on the use of broadened specification hydrocarbon fuels in present day aircraft. A short range Boeing 727 mission and three long range Boeing 747 missions were used as basis of calculation for one-day-per-year extreme values of fuel loading, airport ambient and altitude ambient temperatures with various seasonal and climatic conditions. Four hypothetical fuels were selected; two high-vapor-pressure fuels with 35 kPa and 70 kPa RVP and two high-freezing-point fuels with -29 C and -18 C freezing points. In-flight fuel temperatures were predicted by Boeing's aircraft fuel tank thermal analyzer computer program. Boil-off rates were calculated for the high vapor pressure fuels and heating/insulation requirements for the high freezing point fuels were established. Possible minor and major heating system modifications were investigated with respect to heat output, performance and economic penalties for the high freezing point fuels. Author

N77-27242*# Kanner (Leo) Associates, Redwood City, Calif.

THERMAL STABILITY IMPROVEMENT OF DIESEL FUELS OF ISOPROPYLOCTADECYLAMINE

V. M. Shchagin and V. N. Zrelov Washington NASA Jun. 1977 6 p refs Transl. into ENGLISH from Neftepererabotka i Neftekhimiya (Moscow), no. 4, 1975 p 6-7

(Contract NASw-2790)

(NASA-TT-F-17300) Avail: NTIS HC A02/MF A01 CSCL 21D

The stability of the fuels was increased considerably by adding 0.05 wt.% isopropyl octadecylamine, giving no deposit after 4 hr heating at 150 deg. Loess dust (10 mg/ml fuel), introduced as road impurity into the fuel, had no effect on the stability. Author

N77-27243*# Scientific Translation Service, Santa Barbara, Calif.

EFFECT OF NITROGENOUS BASES ON THE THERMAL STABILITY OF JET FUELS

B. A. Englin, M. P. Alekseyeva, Zh. I. Gasanova, A. V. Isaev, G. B. Skovorodin, and S. M. Borisova Washington NASA Jul. 1977 6 p refs Transl. into ENGLISH from Nefteperera i

Neftekhim. (Moscow), no. 3, 1973 p 9-11
(Contract NASw-2791)
(NASA-TM-75131) Avail: NTIS HC A02/MF A01 CSCL 21D

Fuels from naphthenic petroleums were evaluated, and it was found that they had more N bases than those paraffinic ones (0.00024 and 0.000009% N, respectively). The removal of the N bases improved significantly the thermal stability and reduced the residue formation during oxidation of the fuel. The improvement depended on both content and composition of the bases. Thus, fuels with similar content of N bases (0.00058% N) and thermal stability had oxidation residues of 17.5 and 5.6 and sol. gum of 13 and 1.5 mg/100 ml, before and after removing the N bases, respectively. Author

N77-27244# California Univ., Livermore. Lawrence Livermore Lab.
EFFECT OF A HIGH-ENERGY ELECTRON BEAM ON THE DETONATION VELOCITY OF AN EXPLOSIVE
E. S. Chambers and E. L. Lee 4 Oct. 1976 19 p refs
(Contract W-7405-eng-48)
(UCID-17279) Avail: NTIS HC A02/MF A01

As part a program to study the mechanism of detonation in explosives, the effect of a pulse of high energy electrons on an explosive's detonation velocity was examined. A short, intense burst of 1.1-MeV electrons was directed onto a specimen of XTX-8003 explosive in a narrow track as a detonation wave was passing along it. No change in the detonation velocity resulted from an electron energy fluence of 1.4 J/sq cm. ERA

N77-27245# Energy Research and Development Administration, Bartlesville, Okla. Bartlesville Energy Research Center.
EXPERIMENTAL RESULTS USING METHANOL AND METHANOL/GASOLINE BLENDS AS AUTOMOTIVE ENGINE FUEL
J. R. Allsup Jan. 1977 87 p refs
(BERC/RI-76/15) Avail: NTIS HC A05/MF A01

Comparative emission and fuel energy economy data were generated using 1975 model vehicles adjusted for gasoline fuel and using gasoline and gasoline blended with 5 and 10 percent methanol; tests were made at temperatures of 20, 75, and 100 F on a chassis dynamometer in a climate controlled test chamber. Results suggest that emissions and fuel energy economy are generally affected to the extent that methanol addition affects air-fuel stoichiometry, fuel heat content, and fuel vapor pressure. Vehicle emissions and fuel economy were essentially unchanged during approximately 7,500 miles of road testing; no engine or fuel system component failures were encountered during that testing. Road octane measurements were made for the fuels containing 5, 10, and 15 percent methanol in base gasolines of 84, 87, and 91 research octane quality. Results show significantly better octane improvement in blending methanol with the lower octane fuels as compared with the improvement in blending with the higher octane fuels. GRA

N77-27246# Bureau of Mines, Bartlesville, Okla.
METHANOL AS AUTOMOTIVE FUEL. PART 1: STRAIGHT METHANOL
R. D. Gleming and T. W. Chamberlain 1976 24 p refs Presented at Automotive Eng. Congr. and Exposition, Detroit, 24 Feb. 1975
(CONF-750264-1) Avail: NTIS HC A02/MF A01

Methanol was studied as an automotive fuel using a single-cylinder research engine, a 4-cylinder 122-CID (2,000 cc) engine, and an 8-cylinder 350-CID engine. Results showed that when using methanol as fuel, the single-cylinder engine could operate leaner than the multicylinder engines. This difference is attributable to air-fuel mixture mal-distribution associated with the multicylinder engines. Steady-state fuel economy and emissions data are presented and discussed. Results indicate that fuel economy (on an energy input basis) using methanol fuel is about 5 percent improved as compared to gasoline fuel economy and with substantially lower nitrogen oxides emissions for methanol. ERA

N77-27247# McKee (Arthur G.) and Co., Cleveland, Ohio.
UTILIZATION OF LOW AND INTERMEDIATE BTU GAS FROM COAL FOR IRON ORE PELLETIZING
R. A. Ashworth, K. C. Vyas, and D. G. Bonamer Mar. 1977 283 p
(Contract DI-BM-J0255021)
(PB-264702/2; BM-OFR-36-77) Avail: NTIS HC A13/MF A01 CSCL 11F

Technical and economic feasibility of gasification of low rank solid fuels to provide fuel gas for firing iron ore pelletizing furnaces in northern Minnesota are discussed. Comparisons are made of several types of gasification facilities at individual pellet plants. Costs of retrofitting to grate kiln, traveling grate, and shaft type furnaces are compared. GRA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N77-27248*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HANDBOOK OF ESTIMATING DATA, FACTORS, AND PROCEDURES
Leonard M. Freeman Apr. 1977 140 p refs
(NASA-TM-X-73397) Avail: NTIS HC A07/MF A01 CSCL 13H

Elements to be considered in estimating production costs are discussed in this manual. Guidelines, objectives, and methods for analyzing requirements and work structure are given. Time standards for specific specfic operations are listed for machining, sheet metal working, electroplating and metal treating; painting; silk screening, etching and encapsulating; coil winding; wire preparation and wiring; soldering; and the fabrication of etched circuits and terminal boards. The relation of the various elements of cost to the total cost as proposed for various programs by various contractors is compared with government estimates. Author

N77-27249# Oak Ridge National Lab., Tenn.
CRYOGENIC POWER TRANSMISSION TECHNOLOGY: CRYOGENIC DIELECTRICS Quarterly Report, 1 Apr. - 30 Jun. 1976
Dec. 1976 44 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5608; QR-14) Avail: NTIS HC A03/MF A01

Partial discharge characteristics of three-layer polymer samples, impregnated with helium in a wide range of pressure and temperature (0.3-1.5 MPa and 4.2-12 K), are reported. Electrode-adjacent and mid-dielectric butt gaps are investigated. Results of PD measurements conducted on embossed films and on a sample with a shielded butt gap are discussed. Dc dielectric strength measurements on two layers of cellulose paper, impregnated by helium at 1 MPa and 12 K, are reported. Flashover problems, encountered with dc measurements on polymer films, are also summarized. Results of low temperature resistivity measurments made on a conducting paper are given. Experimental plans for the forthcoming and final quarter of the program are presented. ERA

N77-27250# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
OBSERVATION OF CIRCULATION IN ROTATING SUPERFLUID HELIUM M.S. Thesis
Daniel Richard Starks Dec. 1976 88 p refs
(Contract EY-76-S-02-1569)
(E-1569-139) Avail: NTIS HC A05/MF A01

Observations were made of the circulation of superfluid around a fine wire in a rotating container of He II. Measurements were made using a 25 micron diameter wire at temperatures slightly below 0.5K and at rotation speeds in the range of +2.5 rad/sec. The important new result is the observation of stable reproducible levels of circulation at +1.82 and +2.73 quantum units. It is regarded as significant that these two levels, although not integral, are nevertheless multiples of the same scale factor 0.91. The origin of this scale factor has not been explained, but the fact that the stable levels scale at all is strong support for quantization. ERA

N77-27251# Naval Ship Research and Development Center, Bethesda, Md. Dept. of Ship Performance.
FEASIBILITY OF THE USE OF WATERBORNE PROPULSION FOR LARGE AIR CUSHION VEHICLES
G. Karafiath and T. Csaky Feb. 1977 82 p refs
(AD-A036976; SRD-746-01) Avail: NTIS HC A05/MF A01 CSCL 13/10

Propulsive performance predictions are made for large (1,000, 2,000 and 3,000 ton) Air Cushion Vehicles (ACV) with design speeds of 60, 80 and 100 knots. Several gear train arrangements are investigated and a Z drive with dual downshafts and speed reduction in the pod is selected. Minimum required gear envelopes are used to estimate strut pod sizes. The drag of the resultant base vented strut pod system is estimated. The performance of a supercavitating propeller is calculated at hump and design speed. Based on hump and design speed performance, certain craft configurations are selected. Author (GRA)

N77-27252# National Bureau of Standards, Washington, D. C. Center for Building Technology.
DYNAMIC PERFORMANCE OF A RESIDENTIAL AIR-TO-AIR HEAT PUMP Final Report
George E. Kelley and John Bean Mar. 1977 18 p refs Sponsored in part by FEA
(PB-264932/5; NBS-BSS-93; LC-76-50050) Avail: NTIS HC A02/MF A01 CSCL 13A

Information is presented on the dynamic performance of a 5 ton air to air heat pump, which was installed in a residence in the Washington, D. C. area. The effect of part load operation on the heat pump's cooling and heating coefficients of performance (COP) was determined. When the pump operated in the heating mode at outdoor temperatures below 40F (4.4C), a considerable discrepancy was found to exist between the measured performance and the performance data supplied by the manufacturers. The discrepancy is apparently due to the adverse effects of frost buildup and defrosting of the outdoor coil. GRA

N77-27253# National Bureau of Standards, Washington, D. C.
PERSPECTIVE ON STANDARDS. ACTIVITIES OF THE NATIONAL BUREAU OF STANDARDS Final Report
Madeleine Jacobs and Sharon A. Washburn, ed. 1976 44 p refs
(PB-264814/5; NBS-SP-467) Avail: NTIS HC A03/MF A01 CSCL 05B

This publication highlights the major achievements of the National Bureau of Standards and shows how this work contributes to the solution of many problems of national concern. In addition, sections feature the Bureau's interaction with the public and private sectors and emphasizes the historical perspective in relation to the Bureau's 75th anniversary and the Nation's bicentennial. Sections feature: increasing measurement capabilities; transferring research and technology; promoting better materials use; aiding environmental protection; conserving energy resources; advancing building technology; protecting public safety; improving product performance; expanding computer applications and providing information resources. GRA

N77-27254# California Univ., Los Angeles. Dept. of Energy and Kinetics.
ON RISKS FROM THE STORAGE OF HAZARDOUS CHEMICALS
K. A. Solomon, M. Rubin, and D. Krent Dec. 1976 171 p refs
(Grants NSF GI-39416; NSF OEP-75-20318)
(PB-265115/6; UCLA-ENG-76125; NSF/RA-760464) Avail: NTIS HC A08/MF A01 CSCL 13B

The following approach was used to obtain information on storage of hazardous chemicals: (1) the governors of all fifty states were asked for information concerning the means used by the state in regulating and evaluating risks from storage of potentially hazardous chemicals; (2) a brief survey was made of the measures employed in the cities of Los Angeles and El Segundo, California, in regulating the construction and use of facilities to store hazardous chemicals; and (3) parametric hazard calculations were performed for postulated accidents having assumed population distributions to provide a rough assessment of the potential hazard. A description of the method of surveying the states and the results obtained are given. The results obtained in the survey of Los Angeles and El Segundo are given. The methodology and results of the limited parametric study of potential hazards are reported. The computational model used for postulated accidents caused by different chemicals is included. GRA

N77-27255# National Geodetic Survey, Rockville, Md.
TEST RESULTS OF FIRST-ORDER CLASS III LEVELING
Charles T. Whalen and Emery Balazs Nov. 1976 37 p refs
(PB-265421/8; NOAA-TR-NOS-68; NOAA-TR-NOS-68-NGS-4; NOAA-77012502) Avail: NTIS HC A03/MF A01 CSCL 08E

The National Geodetic Survey has programmed for a partial releveling of the first order, National vertical control net and for readjustment of the entire first- and second-order net during 1977 through 1985. In the past, first-order, class I or II double run leveling was used exclusively to establish and relevel the first-order net. Programmed funds permit releveling and replacing destroyed marks on approximately half of the National first-order net by double-run leveling, or on essentially the entire net by new first-order, class III, single-run leveling. The new specifications, based on an analysis of leveling errors, were field-tested on a level line from Waldorf to Baltimore, Md. between December 1975 and April 1976. Test results indicate that first-order, class III leveling can provide a viable alternative to first-order, class I leveling for releveling the first-order, National vertical control net. GRA

N77-27256# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON EASTERN EUROPE: SCIENTIFIC AFFAIRS, NO. 551
11 Jul. 1977 34 p Transl. into ENGLISH of various Eastern European journals and newspapers
(JPRS-69396) Avail: NTIS HC A03/MF A01

Articles are presented on the development and progress in various theoretical and applied scientific disciplines and technical fields. The administration, structure, personnel, and research plans of leading East European scientific organizations and institutions are discussed. Author

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N77-27257 Ohio State Univ., Columbus.
PASSIVE MICROWAVE MAPPING OF ICE THICKNESS Ph.D. Thesis
John Janis Apinis 1976 154 p
Avail: Univ. Microfilms Order No. 77-2339

The basic calculations from which the feasibility of a scanning microwave radiometer system for mapping the thickness of lake ice may be evaluated are presented. An analytical model for the apparent brightness temperature as a function of ice thickness was developed, and elaborated to include such variables as galactic and atmospheric noise, aspect angle, polarization, temperature gradient in the ice, the presence of transition layers such as snow, slush, and water, increased loss due to air inclusions in the ice layer, and the presence of multiple ice thicknesses within the antenna footprint. It was found that brightness temperature measurements at six or seven frequencies in the range of 0.4 to 0.7 GHz were required to obtain unambiguous thickness estimates. A number of data processing methods were examined. Dissert. Abstr.

N77-27258*# TRW Defense and Space Systems Group, Redondo Beach, Calif. Plasma Physics Dept.
FINAL REPORT ON TECHNICAL WORK ACCOMPLISHED UNDER CONTRACT NASW-2953 Final Report, 1 Jul. 1976 - 30 Jun. 1977
R. W. Fredricks 30 Jun. 1977 148 p refs
(Contract NASw-2953)
(NASA-CR-153294; TRW-29697-6002-RU-00) Avail: NTIS

HC A07/MF A01 CSCL 20N

A report is given on the technical work accomplished in the area of plasma physics. The subjects covered are: (1) oblique whistler instabilities, (2) current-limited electron beam injection, (3) three-dimensional ion sound turbulence, (4) theoretical aspects of sounder antenna operation and (5) whistler modes in bow shock structures. For individual titles, see N77-27259 through N77-27263.

N77-27259*# TRW Defense and Space Systems Group, Redondo Beach, Calif.

OBLIQUE WHISTLER INSTABILITIES

Reiner L. Stenzel *In its* Final Report on Tech. Work Accomplished under contract NASw-2953 30 Jun. 1977 44 p refs (For primary document see N77-27258 18-32)
(Contract NASw-2953)
Avail: NTIS HC A07/MF A01

The predicted instability of obliquely propagating whistler waves in a plasma penetrated by an electron beam is verified in a laboratory experiment. The observations support the model for the generation of auroral hiss and compare favorably with ground and satellite observations of VLF hiss. In contrast to the conventional small-diameter laboratory beam-plasma systems the device used is large compared to the characteristic whistler wavelength. Unstable whistlers can therefore, propagate and grow oblique to the beam over many wavelengths before encountering the plasma boundaries. Author.

N77-27260*# TRW Defense and Space Systems Group, Redondo Beach, Calif.

CURRENT-LIMITED ELECTRON BEAM INJECTION

Reiner L. Stenzel *In its* Final Rept. on Tech. Work Accomplished under contract NASw-2953 30 Jun. 1977 31 p refs (For primary document see N77-27258 18-32)
(Contract NASw-2953)
Avail: NTIS HC A07/MF A01

The injection of an electron beam into a weakly collisional, magnetized background plasma was investigated experimentally. The injected beam was energetic and cold, the background plasma was initially isothermal. Beam and plasma dimensions were so large that the system was considered unbounded. The temporal and spatial evolution of the beam-plasma system was dominated by collective effects. High-frequency electrostatic instabilities rapidly thermalized the beam and heated the background electrons. The injected beam current was balanced by a return current consisting of background electrons drifting toward the beam source. The drift between electrons and ions gave rise to an ion acoustic instability which developed into strong three-dimensional turbulence. It was shown that the injected beam current was limited by the return current which is approximately given by the electron saturation current. Non-Maxwellian electron distribution functions were observed. Author

N77-27261*# TRW Defense and Space Systems Group, Redondo Beach, Calif.

THREE-DIMENSIONAL ION SOUND TURBULENCE

Reiner L. Stenzel *In its* Final Report. on Tech. Work Accomplished under contract NASw-2953 30 Jun. 1977 51 p refs (For primary document see N77-27258 18-32)
(Contract NASw-2953)
Avail: NTIS HC A07/MF A01

A fast cold large diameter electron beam is injected into a uniform background plasma. The injected beam current is balanced by a field-aligned return current which gives rise to an ion acoustic instability. The plasma is essentially unbounded and collisionless on the time scale of the pulsed experiment. The fluctuations are analyzed by probe techniques in real time and space as well as in the frequency and wavenumber domains. Strong density fluctuations are observed in the entire ion acoustic spectrum reaching peak amplitudes at the low frequency end. The propagation of phase coherent test waves in the current carrying plasma is investigated. For the highly turbulent regime strong damping is observed while at lower drift velocities direction is observed. Oblique propagation of two strong test waves at different frequencies indicate the role of nonlinear ion Landau damping in absorption of wave energy. Author

N77-27262*# TRW Defense and Space Systems Group, Redondo Beach, Calif.

THEORETICAL ASPECTS OF SOUNDER ANTENNA OPERATION

R. W. Fredricks *In its* Final Rept. on Tech. Work Accomplished under contract NASw-2953 30 Jun. 1977 12 p refs (For primary document see N77-27258 18-32)
(Contract NASw-2953)
Avail: NTIS HC A07/MF A01

The fundamental problem of calculating the radiation from an electric dipole immersed in a magnetoplasma is one of solving Maxwell's equations coupled to the self-consistent field-particle equations describing the plasma. For very small applied antenna voltages, the plasma dynamics may be linearized, and the plasma reaction currents computed self-consistently in terms of the voltage on the antenna. Thus, the short dipole can be idealized as a point dipole of moment P sub o = C sub a, V sub o el, where C sub a is the antenna element-to-plasma capacitance for a sheath of dimensions roughly several plasma Debye lengths and el is the dipole element's length. In actual practice, it is at this point that the first difficulty with the antenna theory arises. Even for small signals, the sheath around such an antenna will exhibit a complex impedance. For larger signals, nonlinear effects appear. Attemps are made to solve this problem. Author

N77-27263*# TRW Defense and Space Systems Group, Redondo Beach, Calif.

WHISTLER MODES IN BOW SHOCKS

E. W. Greenstadt *In its* Final Rept. on Tech. Work Accomplished under contract NASw-2953 30 Jun. 1977 7 p refs (For primary document see N77-27258 18-32)
(Contract NASw-2953)
Avail: NTIS HC A07/MF A01

The behavior of the whistler mode is characterized for arbitrary angles of propagation to B, under representative solar wind conditions. Author

N77-27264*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

TEST AND EVALUATION OF WATER VAPOR RADIOMETERS AND DETERMINATION OF THEIR CAPABILITY TO MEASURE TROPOSPHERIC PROPAGATION PATH LENGTH
Final Report

J. M. Moran and H. Penfield Jun. 1976 99 p refs
(Contract NAS5-20975)
(NASA-CR-144840) Avail: NTIS HC A05/MF A01 CSCL 20N

Two dual frequency microwave radiometers were refurbished and placed in operation on steerable search light mounts. A total of 330 radiosonde profiles were examined. The wet path length had a mean value of 17 cm with an rms deviation of 7 cm in the summer and a mean value of 5 cm with an rms deviation of 2 cm in the winter. Using surface meteorology or radiosonde profiles at remote sites the wet path could be estimated to an accuracy of 5 cm in the summer and 2 cm in the winter. The estimate from brightness temperature at 19 and 22 GHz was better than 0.3 cm. The brightness temperatures measured with the radiometers were compared with the brightness temperatures calculated from radiosonde profiles during an eleven day experiment in August 1975 during which 45 radiosondes were launched. The rms residual in the correlation between measured brightness temperature and the calculated wet path length in the zenith direction was 1.5 cm. Author

N77-27265# Texas A&M Univ., College Station. Remote Sensing Center.

THE POTENTIAL OF INCORPORATING A SYNTHETIC APERTURE RADAR CAPABILITY INTO THE METEOROLOGICAL RADAR FACILITY

J. P. Claassen May 1977 53 p refs
(RSC-87) Avail: NTIS HC A04/MF A01 CSCL 17I

A composite MRF-SAR system would not only measure precipitation in rainy regions but could provide moderate to high resolution radar images in clear and cloudy (but not precipitating) regions. It is shown that the MRF configuration is very conducive for implementing an imaging radar having many noteworthy features. The multibeam characteristic of the MRF circumvents the normal radar ambiguity problems and, consequently, can

achieve a swath much wider than that realized by a conventional design. Furthermore, as a result of the high directivity achieved in each receiving beam, the transmitter power requirement is reduced substantially in comparison to a single radar beam offering the same coverage. Since radar returns can be strongly dependent on the angle of illumination, the nearly constant angle of incidence of the MRF beams should significantly ease the interpretation of the resulting radar image. It is recommended that this preliminary effort be extended to fully demonstrate the feasibility of such a composite system. Author

N77-27266*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASUREMENTS OF AAFE RADSCAT ANTENNA CHARACTERISTICS
Aubrey E. Cross, W. Linwood Jones, Jr., and Alfred L. Jones Jun. 1977 42 p refs
(NASA-TM-X-72844) Avail: NTIS HC A03/MF A01 CSCL 20N

Antenna characteristics (active and passive) for a modified AAFE-RADSCAT parabolic dish antenna are documented for a variety of antenna configurations. The modified antenna was a replacement for the original unit which was damaged in January 1975. Pattern measurements made at Langley Research Center and Johnson Space Center are presented, with an analysis of the results. Antenna loss measurements are also presented and summarized. Author

N77-27267*# Hulburt (E. O.) Center for Space Research, Washington, D.C.
FAR-ULTRAVIOLET ROCKET ASTRONOMY PROGRAM Progress Report
George R. Carruthers 16 Dec. 1976 12 p
(NASA Order W-13089)
(NASA-CR-153270) Avail: NTIS HC A02/MF A01 CSCL 17B

The launch of sounding rocket 26.056 DG on 29 October 1976 is described and quick-look results from that mission are given. Also further work on data obtained by 13.118 DG, launched 5 December 1975 is reported. Author

N77-27268*# Georgia Inst. of Tech., Atlanta. Electromagnetics Lab.
RESEARCH IN MILLIMETER WAVE TECHNIQUES Semiannual Status Report, 15 Dec. 1976 - 15 Jun. 1977
R. W. McMillan 15 Jul. 1977 138 p refs
(Grant NsG-5012)
(NASA-CR-153742; SATR-6) Avail: NTIS HC A07/MF A01 CSCL 20N

The following is investigated; (1) the design of a 183 GHz single ended fundamental mixer to serve as a back up mixer to the subharmonic mixer for airborne applications, (2) attainment of 6 db single sideband conversion loss with the 6 GHz subharmonic mixer model, together with initial tests to determine the feasibility of pumping the mixer at w sub s/4, (3) additional ground based radiometric measurements, and (4) derivation of equations for power transmission of wire grid interferometers, and initial tests to verify these equations. Author

N77-27269*# Kanner (Leo) Associates, Redwood City, Calif.
STATUS AND DEVELOPMENT PERSPECTIVES OF COMMUNICATIONS SATELLITES
H. D. Naumann Washington NASA Jun. 1977 18 p refs Transl. into ENGLISH from Astron. Raumfahrt (West Germany), no. 1, 1976 p 15-20 Original language document was announced as A76-24840
(Contract NASw-2790)
(NASA-TT-F-17368) Avail: NTIS HC A02/MF A01 CSCL 17B

The current status of communication satellite technology is examined, taking into account the installations maintained by Intelsat, the SPADE technique, FDMA, and TDMA. A number of experiments are needed to obtain optimal and cost-efficient solutions with the aid of time division multiple access (TDMA) techniques. In a review of the possibilities for further development of the communication satellite systems, the various communication functions and services which can be provided by satellites are considered. Attention is also given to the employment of regional satellite systems, orbital problems, transmission frequencies, and new technical transmission techniques. Author

N77-27270# National Aviation Facilities Experimental Center, Atlantic City, N. J.
TEST AND EVALUATION OF THE RADAR PROCESSING SUBSYSTEMS OF THE ALL DIGITAL TRACKING LEVEL SYSTEM Interim Report, Mar. 1975 - Feb. 1976
Martin Holtz and Leo Wapelhorst Mar. 1977 150 p ref
(AD-A038624; FAA-NA-76-22; FAA-RD-76-197) Avail: NTIS HC A07/MF A01 CSCL 17/9

The radar processing subsystem of the all digital tracking level system was primarily evaluated on target detection sensitivity, false target rates in clutter and clutter-free environments, clutter mapping, and quantizer regulation. The tests consisted of bench tests and tests employing weather clutter samples. The quantizer model, designed and fabricated by NAFEC, was successful in achieving expected results. The second-threshold control function regulated false targets in weather clutter environments to a half order of magnitude of a 1 X 10 to the minus 5 rate. Target detection sensitivity was acceptable, but could be improved by utilizing a hardware detector that does not employ a predetector function. Author

N77-27271# National Aviation Facilities Experimental Center, Atlantic City, N. J.
EVALUATION OF VERY HIGH FREQUENCY INTERFERENCE CANCELLATION SYSTEM Final Report, Feb. - Aug. 1976
Charles G. Santora Mar. 1977 45 p
(AD-A038850; FAA-76-44; FAA-RD-77-15) Avail: NTIS HC A03/MF A01 CSCL 17/2

A device is described that can be used at sites such as remote center airground facilities and flight service stations to counteract the interference due to reception of strong signals from collocated transmitters. The interference cancellation system unit tested handled up to four interfering transmitters and was found to perform as specified and reduce received interfering signals at power levels up to +10 decibels referred to 1 milliwatt (dbm) down to at least -45 dbm. Author

N77-27272*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
QUADRAPHASE DEMODULATION Patent Application
Carl R. Ryan, inventor (to NASA) (Motorola, Inc., Scottsdale, Ariz.) Filed 21 Jun. 1977 17 p Sponsored by NASA
(NASA-Case-GSC-12137-1; US-Patent-Appl-SN-808510) Avail: NTIS HC A02/MF A01 CSCL 17B

A received, suppressed carrier, quadraphase shift key modulated (QPSK) signal is demodulated with a phase locked loop including a variable frequency, coherent reference that drives first and second channels also responsive to the QPSK signal. The channels respectively derive first and second replicas of binary signals that modulated the suppressed carrier. The replicas are combined to derive a variable amplitude error signal for controlling the coherent reference frequency. The frequency of the coherent reference is dithered at a low rate to derive a relatively low level tracking error phase from the locked loop. The frequency of the coherent reference is swept when the phase of the error signal differs from the dithering phase by a predetermined value that is appreciably less than 90 deg. NASA

N77-27273*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SCATTERING IN DISCRETE RANDOM MEDIA WITH IMPLICATIONS TO PROPAGATION THROUGH RAIN Ph.D. Thesis George Washington Univ., Washington, D.C.
Louis Joseph Ippolito, Jr. May 1977 119 p refs
(NASA-TM-X-71352; X-953-77-131) Avail: NTIS HC A06/MF A01 CSCL 20N

The multiple scattering effects on wave propagation through a volume of discrete scatterers were investigated. The mean field and intensity for a distribution of scatterers was developed using a discrete random media formulation, and second order series expansions for the mean field and total intensity derived for one-dimensional and three-dimensional configurations. The volume distribution results were shown to proceed directly from the one-dimensional results. The multiple scattering intensity expansion was compared to the classical single scattering

intensity and the classical result was found to represent only the first three terms in the total intensity expansion. The Foldy approximation to the mean field was applied to develop the coherent intensity, and was found to exactly represent all coherent terms of the total intensity. Author

N77-27274# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DESCRIPTION AND PERFORMANCE EVALUATION OF THE MOVING TARGET DETECTOR Final Project Report
L. Cartledge and R. M. ODonnell 8 Mar. 1977 224 p refs Sponsored by FAA
(Contract F19628-76-C-0002)
(AD-A040055; ATC-69; FAA-RD-76-190) Avail: NTIS HC A10/MF A01 CSCL 17/9

New techniques were developed which significantly enhance automated aircraft detection in all forms of clutter. These techniques are embodied in a digital processor called the moving target detector (MTD). This processor was integrated into the ARTS-3 system, and tested. The MTD design and its evaluation tests are described, and the significance of the results are discussed. The detection performance of the MTD was excellent in the clear, in rain and ground clutter, and false alarms were under complete control. The MTD processed range and azimuth data were very accurate, and the MTD did not suffer from track dropouts as did the conventional MTI when the aircraft track became tangential to the radar. Performance was excellent on magnetron as well as klystron-type radars with the exception of second-time-around clutter cancellation. Author

N77-27275# California Univ., Berkeley. Lawrence Berkeley Lab.
THEOREMS REGARDING POWER SCATTERED FROM A LOSSLESS LINEAR 1-PORT ANTENNA
R. M. Bevensee Jul. 1976 24 p refs Presented at APS/URSI Conf., Amherst, Mass., 11-15 Oct. 1976
(Contracts W-7405-eng-48; DNA Proj. R99-QAXEB075)
(UCRL-78464; Conf-761063-1) Avail: NTIS HC A02/MF A01

Theorems are presented, in which it is assumed that a linear, lossless, one port antenna is imbedded in a linear, lossless, reciprocal medium, with a linear passive load attached to the port as a receiver-scatterer of power. Also, the antenna is excited as a receiver by an external source of field in fixed position at a single frequency. Given these assumptions and based on a scattering equivalent circuit for power, the theorems express the load for maximum and minimum scattered power for a given crosspower coefficient and the maximum scattered power for the most favorable coefficient. ERA

N77-27276# Raytheon Co., Bedford, Mass. Missile Systems Div.
TAGSEA PROGRAM. VOLUME 4: STANDARD CLUTTER ANALYSIS OUTPUTS Final Report
27 Aug. 1976 555 p Prepared for General Dynamics, Pomona, Calif. 4 Vol.
(Contract N00017-73-C-2244)
(AD-A036974; BR-9254-4) Avail: NTIS HC A24/MF A01 CSCL 17/9

Contents: Outputs-Histogram Analysis; Outputs-Hit Analysis; Outputs-Average Analysis; and Outputs-Spatial and Temporal Analysis. GRA

N77-27277# Raytheon Co., Bedford, Mass.
TAGSEA PROGRAM. VOLUME 3: SUPPORTIVE ANALYSES AND OUTPUTS Final Report
27 Aug. 1976 358 p Prepared for General Dynamics, Pomona, Calif. 4 Vol.
(Contract N00017-73-C-2244)
(AD-A036973; BR-9254-3) Avail: NTIS HC A16/MF A01 CSCL 17/9

Contents: Supportive Analysis; Outputs-Special Analysis; Environmental Conditions; Data Analysis Software; Simulation Software; and Simulation Outputs. GRA

N77-27278# Raytheon Co., Bedford, Mass.
TAGSEA PROGRAM. VOLUME 2: PROCEDURES AND OUTPUT FORMS Final Report
27 Aug. 1976 191 p Prepared for General Dynamics, Pomona, Calif. 4 Vol.
(Contract N00017-73-C-2244)
(AD-A036972; BR-9254-2) Avail: NTIS HC A09/MF A01 CSCL 17/9

Equipment used in clutter data gathering, reduction and analysis included; the ARTS (Active Radar Test System) radar, associated pod mounted units, recording equipment in the A-3 aircraft, non-real time data reduction test equipment and a computer for analysis. GRA

N77-27279# General Dynamics/Pomona, Calif.
TAGSEA PROGRAM. VOLUME 1: CLUTTER MODELS Final Report
27 Aug. 1976 110 p refs Prepared by Raytheon Co., Bedford, Mass.
(Contract N00017-73-C-2244)
(AD-A036971; BR-9254-1-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 17/9

Radar sea clutter modeling, with associated data gathering and analysis, is reported with specific emphasis on clutter returns with a probability of occurrence of a minimum of 1 in 1,000,000 referenced to the mean. Data was gathered and reduced as a function of sea state, wind direction, grazing angle and polarization off the East and West Coasts with a basic radar resolution of 100 by 100 feet at X-band. Analyses reported characterize sea clutter in terms of mean clutter backscatter coefficient sigma sub 0, probability density, statistical variability, temporal and spatial power spectral density and autocorrelation function, and conditional probability. Models of sea clutter are formulated (and validated by simulation) with several levels of refinement for use primarily in specification, design and evaluation of missile systems. The material is presented in a form to be useful in other applications as well. Although this report is presented in four volumes, attention should be directed primarily to Volume 1 which, on a stand-alone basis, contains an overview and presents summarized results and the full clutter models. GRA

N77-27280# Technology Service Corp., Silver Spring, Md.
TAGSEA CLUTTER MEASUREMENT VERIFICATION
L. W. Brooks, F. E. Nathanson, and P. R. Brooks 29 Oct. 1976 67 p refs Prepared for APL, Laurel, Md.
(Contract N00017-72-C-4401)
(AD-A037249; B50711; TSC-WO-284r) Avail: NTIS HC A04/MF A01 CSCL 17/9

This is the final TSC report on our overview of the TAGSEA sea clutter measurement program. It includes some general comments on the techniques used by Raytheon and General Dynamics in obtaining the data, the data reduction, and test results. Since the early discussions on procedures and tests were covered in monthly meetings and reported earlier, this report emphasizes the validity of the results and their use in relating sea clutter models for Navy use. TSC has no reason to question the validity of the data itself. While the system was not designed for quantitative measurement of sigma sub zero, the results should be accurate to within a few decibels (+ or - 3 db(2 sigma)). Both Raytheon and General Dynamics appear to have performed good tests in the time allotted. Two areas deserve special attention. While the measurement of sea reflectivity, sigma sub zero, was not a primary function of the tests, the results showed the greatest deviation from earlier models. For grazing angles of 10 deg - psi - 45 deg, the TAGSEA mean values of sigma sub zero were 6-9 db higher than earlier models, especially those of NRL for the higher sea states (SS=4). It is proposed in Section 3 that TSC believes that the TAGSEA results are probably more representative of high sea state reflectivity than the earlier models and that some values in new models should be raised by 4-6 db. GRA

N77-27281# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
A STUDY OF THE EFFECTS OF TEMPERATURE VARIATIONS ON RADIO WAVE ABSORPTION
Roberto Rubio, Robert O. Olsen, Jack Smith, and Daniel B. Stammer Fort Monmouth, N. J. Nov. 1976 38 p refs
(AD-A037645; ECOM-5807) Avail: NTIS HC A03/MF A01 CSCL 17/2

During certain days in winter, radio waves experience higher

than usual amounts of absorption. A possible cause of these anomalous winter days is mesospheric temperature variations which alter the electron collision frequencies and indirectly enhance radio wave absorption. The effects of temperature variations on radio wave absorption are discussed in this report. Electron collision frequencies are determined for different temperature profiles and to account for absorption due to electron density variations. Electron density profiles on certain days during the 1972 winter months of January and February are obtained from partial reflection sounder data, C3 sounder ionograms, and a model. The electron collision frequencies and electron densities are used to calculate the absorption of a 5 MHz signal transmitted from Fort Collins, Colorado, to White Sands Missile Range, New Mexico. The absorption calculations are made by utilizing the Appleton-Hartree equations. Absorption calculations show that temperature increases can cause a significant increase in collision frequency; however, the amount of the absorption increases was found to be critically dependent on the altitude of reflection of the 5MHz signal. GRA

N77-27282# Lincoln Lab., Mass. Inst. of Tech., Lexington.
INPUT BUFFER DESIGNS FOR A RADAR SIGNAL PROCESSOR
Albert H. Huntoon 20 Jan. 1977 88 p refs
(Contract F19628-76-C-0002)
(AD-A037120; TN-1977-3; ESD-TR-77-26) Avail: NTIS HC A05/MF A01 CSCL 09/2

Three Input Buffer designs which provide intermediate storage between the Analog to Digital Converters and the Digital Matched Filter of a Radar Signal Processor are presented. All designs use a basic all-ECL buffer module. Prototype hardware experiments indicate that with 8:1 input data multiplexing, ECL 10K technology will yield input rates up to 142 Ms/s per channel, and output rates of 45 Ms/s per convolver rail. Author (GRA)

N77-27283# Stanford Univ., Calif. Digital Systems Lab.
A DISTRIBUTED ALGORITHM FOR CONSTRUCTING MINIMAL SPANNING TREES IN COMPUTER-COMMUNICATION NETWORKS
Yogen K. Dalal Jun. 1976 50 p refs
(Contract MDA903-76-C-0093; Grant NSF MCS-73-07973-A1/2; ARPA Order 2494)
(AD-A037222; SU-TR-111) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper presents a distributed algorithm for constructing minimal spanning trees in computer-communication networks. The algorithm can be executed concurrently and asynchronously by the different computers of the network. This algorithm is also suitable for constructing minimal spanning trees using a multiprocessor computer system. There are many reasons for constructing minimal spanning trees in computer-communication networks since minimal spanning tree routing is useful in distributed operating systems for performing broadcase, in adaptive routing algorithms for transmitting delay estimates, and in other networks like the Packet Radio Network. Author (GRA)

N77-27284# Georgia Inst. of Tech., Atlanta. Electronics Technology Lab.
INTERACTIVE COMMUNICATION SYSTEMS MODELING STUDY Final Technical Report, Jun. 1975 - Aug. 1976
Richard W. Moss, Robert M. Rice, and Donald R. Sentz Griffiss AFB, N. Y. RADC Feb. 1977 311 p refs
(Contract F30602-75-C-0247)
(AD-A037833; RADC-TR-77-42) Avail: NTIS HC A14/MF A01 CSCL 09/2

This report deals with an effort to develop an interactive computer model for analysis and design of digital communications systems. In this report concepts are formulated and described for a Model for Interactive Design and Analysis of Communication Systems (MIDACS). Methods of approach for concept formulation are described, examples of previous modeling approaches are presented, characteristics of the MIDACS concept are documented, and a representative computer model is described. Various interactive approaches are shown along with general hardware and software requirements. The formulated interactive concept includes the computer, display devices, and other input/output devices. Mathematical modeling approaches are described including standard Monte Carlo techniques, deterministic methods, and analytical models. The recommended modeling structure includes a modified Monte Carlo technique to minimize computer time for certain communication system performance measures. A multi-level analysis structure is recommended which includes a hierarchy for the physical model combined with a hierarchy of analysis levels which permits greatest computer use flexibility. The recommended programming structure is described including the development chain, software composition, and approach to software development. Function and system library elements are identified and MIDACS hardware requirements are stated. Author (GRA)

N77-27285# Rome Air Development Center, Griffiss AFB, N.Y.
VLF/LF PROPAGATION MEASUREMENTS OVER LONG PATHS ON BOARD A HIGH-SPEED AIRCRAFT
Wayne Bonser and Anthony J. Mlinar Feb. 1977 139 p
(AD-A038018; RADC-TM-76-16) Avail: NTIS HC A07/MF A01 CSCL 20/14

Field strength measurements in the Very-Low-Frequency and Low-Frequency (VLF/LF) range are being conducted around the Western Hemisphere on board RADC's KC 135 aircraft. Data from these flights will provide a basis on which present propagation prediction models can be compared. Adjustment of present prediction models to real-world data will provide the Armed Services with reliable and accurate means of predicting message reception success and, hence, allow Command and Control to make the necessary communications adjustments for insuring the most reliable message transmission. This report describes the flights and data collected on paths from Griffiss AFB, NY to Mildenhall, England, and return; Griffiss AFB to March AFB, CA then to Eielson AFB, Alaska, and return to Griffiss AFB; and a round-robin flight from Griffiss AFB to the area around and over Silver Creek, Nebraska, and return. The frequencies monitored were: 34.5 kHz Silver Creek; 36 kHz Forestport, NY; 37.2 kHz Hawes, CA; 60 kHz WWVB, Boulder, Colorado; and 19.6 kHz - GBZ - Criggion, England. Author (GRA)

N77-27286# AEL Service Corp., Farmingdale, N. J.
ELECTROMAGNETIC RADIATION SYSTEM (EMRS) FOR SUSCEPTIBILITY TESTING Interim Report, 3 May - 29 Oct. 1976
Edwin S. Iskra Feb. 1977 51 p
(Contract DAAB07-76-C-0332)
(AD-A037097; AELSC-TR-23-3; ECOM-76-0332-3) Avail: NTIS HC A04/MF A01 CSCL 20/14

The function of the Electromagnetic Radiation System (EMRS) is to generate electromagnetic energy so as to produce a constant field strength that can be automatically scanned as a function of frequency. The design objective is to cover the frequency range of 30 hertz to 40 gigahertz with field strength intensities up to 200 volts per meter. A stripline approach is described and proposed for use as the field generating device for the lower frequencies. Refocused parabolas are proposed for use at the higher frequencies. Author (GRA)

N77-27287# Mississippi Univ., University.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THIN-WIRE STRUCTURES: JUNCTION CONDITIONS, CURRENTS AND CHARGES Final Report
Charmers M. Butler, Bob M. Duff, Edward Yung, Santiago Singarayar, and Ronold W. P. King (Harvard Univ., Cambridge, Mass.) Kirtland AFB, N. Mex. AFWL Mar. 1977 174 p refs Prepared for Dikewood Corp., Albuquerque, N. Mex.
(Contract F29601-74-C-0010)
(AD-A037497; AFWL-TR-75-106) Avail: NTIS HC A08/MF A01 CSCL 20/14

In this report, the electromagnetic boundary conditions applicable at the confluence or junction of two or more thin wires are investigated theoretically, numerically, and experimentally. Current and charge distributions determined from iterative and numerical solutions, as well as from measurements, are provided for fundamental thin-wire structures: stepped-radius wire, bent wire, and experimental results are presented. Author (GRA)

N77-27288# Naval Electronics Lab. Center, San Diego, Calif.
ELECTROMAGNETIC SYSTEM INTERACTION ALGORITHMS SEMCA, IPM, TRED, AND COSAM ARE COM-

PARED WITH RESPECT TO MODELING PHILOSOPHY, FLEXIBILITY, DATA BASE, NOISES AND INTERFERENCES, INTERFERENCE THRESHOLD CRITERIA, ATTENUATION MODELING AND ANTENNA COUPLING, AND PRINTOUTS

S. T. Li 3 Jan. 1977 62 p refs
(XF54585004)
(AD-A037903; NELC-TD-506) Avail: NTIS HC A04/MF A01 CSCL 20/14

TRED is a system design tool while SEMCA, IPM, and COSAM are mainly used as interference prediction tools. A user-computer interactive program is recommended. It would be based on the TRED design philosophy and would be used during the design stage of shipboard RF communication systems. In addition, a performance evaluation program for shipboard RF communication systems is recommended. The purpose of the evaluation is to predict final system performance in terms of articulation index and bit error rate. Author (GRA)

N77-27289# Naval Research Lab., Washington, D. C.
SUBMILLIMETER WAVE PRODUCTION BY UPSHIFTED REFLECTION FROM A MOVING IONIZATION FRONT Interim Report

M. Lampe, E. Ott (Cornell Univ., Ithaca, N. Y.), W. M. Manheimer, and S. Kainer Mar. 1977 16 p refs
(AD-A037613; NRL-MR-3468) Avail: NTIS HC A02/MF A01 CSCL 20/14

The Doppler shift and reflection coefficients are calculated for reflection of an EM wave from a moving ionization front in a stationary gas. It is suggested that this process can be used to upshift microwaves to submillimeter waves. Author (GRA)

N77-27290# Office of the Director of Defense Research and Engineering, Washington, D. C.
PROCEEDINGS OF THE OPTICAL-SUBMILLIMETER ATMOSPHERIC PROPAGATION CONFERENCE. VOLUME 1: UNCLASSIFIED PAPERS

9 Dec. 1976 510 p refs Conf. held at AF Academy, Colo., 6-9 Dec. 1976
(AD-A037812) Avail: NTIS HC A22/MF A01 CSCL 20/14

This report is one of a two volume set of papers submitted for presentation at the Optical-Submillimeter Atmospheric Propagation Conference held at the U.S. Air Force Academy on 6-9 December 1976. Volume 1 contains all unclassified papers, and Volume 2 contains those papers which are classified.
Author (GRA)

N77-27291# Sachs/Freeman Associates, Inc., Hyattsville, Md.
SIGNAL-TO-INTERFERENCE PROTECTION RATIOS FOR HF MARITIME MOBILE SERVICES

E. R. Freeman and H. M. Sachs Oct. 1976 12 p refs Sponsored by the Navy
(AD-A037135) Avail: NTIS HC A02/MF A01 CSCL 20/14

HF maritime mobile services signals are characterized by widely fluctuating signal levels. The purpose of this report is to present a method of integrating certain factors into a model for the determination of a minimum acceptable signal-to-interference (S/I) ratio. GRA

N77-27292# Washington Univ., Seattle. Dept. of Electrical Engineering.
PROPAGATION AND RECEPTION OF PARTIALLY COHERENT WAVES IN RANDOM MEDIA Final Report, 1 Jul. 1973 - 30 Sep. 1976

Akira Ishimaru Griffiss AFB, N. Y. RADC Jan. 1977 14 p refs
(Contract F19628-74-C-0005)
(AD-A037010; UN-EE-TR-200; RADC-TR-77-26) Avail: NTIS HC A02/MF A01 CSCL 20/14

This work covers a broad spectrum including wide-band pulse propagation in a time-varying medium, turbulence, fog, rain, cloud and other discrete scatterers, relationship between transport theory and multiple scattering theory, backscattering of pulses, remote-sensing, intensity fluctuations, coherence bandwidth, coherence time, and pulse shape distortion of millimeter waves in rain, fog, and turbulence radiometric measurement of rain attenuation. GRA

N77-27293# California Univ., Los Angeles. Dept. of Computer Science.
ADVANCED TELEPROCESSING SYSTEMS Semiannual Technical Report, 1 Jul. - 31 Dec. 1976

Leonard Kleinrock, Gerald Estrin, Richard Muntz, and Gerald Popek Dec. 1976 257 p refs
(Contract DAHC15-73-C-0368)
(AD-A039018) Avail: NTIS HC A12/MF A01 CSCL 09/2

The constantly growing need for access to computers, communication channels and distributed computer communication networks renders the problem of allocating these large, expensive, resources among an ever increasing number of users a rather fundamental one. It is projected that by 1980 approximately four to five million data terminals will be in use in the United States, and it is estimated that the data traffic in seventeen western European countries will grow by a factor of six .from 1972 to 1980. A study was made of the allocation of a data communication channel; the demands placed upon this scarce resource as made by a population of users are considered. GRA

N77-27294# Perceptronics, Inc., Woodland Hills, Calif.
APPLICATION OF ADAPTIVE MODELS TO INFORMATION SELECTION IN C3 SYSTEMS Technical Report, 1 Mar. - 30 Sep. 1976

Michael T. Samet, Gershon Weltman, and Kent B. Davis 31 Dec. 1976 101 p refs
(Contract MDA903-76-C-0241)
(AD-A038523; PTR-1033-76-12) Avail: NTIS HC A06/MF A01 CSCL 17/2

This report describes research and development centered on the demonstration of an on-line adaptive model for automatically selecting information in a command, control, and communication (C3) system. Rationale for application of the model is built upon a review of psychological literature concerning human performance in specifying information requirements, and in acquiring and utilizing information for military decision making. Based on a multi-attribute decomposition of information messages, the model selects information for an individual user according to his observed information preferences in response to specific situational requirements. An additional algorithm reduces the size of a selected information set by dynamically pruning relatively low-utility items. The model was implemented for a simulated ASW tracking task, and was systematically evaluated in terms of both its intrinsic performance and the performance of an expert operator working with it. The results demonstrated the capability of the model to adapt to varied individualized information seeking strategies, and to subsequently automate the selection of information appropriate to those strategies. GRA

N77-27295# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
COEFFICIENT AND DATA QUANTIZATION IN MATCHED FILTERS FOR DETECTION Interim Report

Tong Leong Lim and Saleem A. Kassam 1977 9 p refs Presented at Conf. on Information Sci. and Systems, Johns Hopkins Univ., Mar. 1977
(Grant AF-AFOSR-3154-77)
(AD-A039041) Avail: NTIS HC A02/MF A01 CSCL 09/5

Quantization of data and representation of the coefficients are studied in digital matched filters for weak-signal detection. An algorithm for optimum coefficients and equations for the optimum input quantizer are obtained for the known signal in additive noise problems. Some numerical performance results are given. Author (GRA)

N77-27296# Rome Air Development Center, Griffiss AFB, N.Y.
A SURVEY OF ANTENNA ARRAY TECHNOLOGY FOR SURVEILLANCE SYSTEMS Final Report

Walter S. Gregorwich Feb. 1977 32 p refs
(AD-A038814; RADC-TR-76-409) Avail: NTIS HC A03/MF A01 CSCL 09/5

This report acquaints the reader with a survey of the latest state-of-the-art technology that may be applicable to various types of ground signal collection systems. An overview of the performance parameters of both planar and lens fed arrays is presented. An extensive bibliography is a key feature of this report. Author (GRA)

N77-27297# Rome Air Development Center, Griffiss AFB, N.Y.
ANALYSIS OF A DUAL FREQUENCY ARRAY TECHNIQUE
R. J. Mailloux and H. Steyskal Jan. 1977 31 p refs
(AD-A038834; RADC-TR-77-48) Avail: NTIS
HC A03/MF A01 CSCL 09/5

This report presents analytical results that describe the radiating properties of a new element for a dual frequency phased array. This basic element operates over two frequency bands which are separated by about an octave. The analysis considers the array element excited by two waveguides for high frequency operation, and includes an evaluation of the element radiation properties at both frequency bands. The analysis of radiation is carried out for the case of H-plane scan, which is expected to be the most severe test of the element's scanning behavior. Computed results indicate that the structure radiates efficiently within the two bands and operates free from anomalous behavior over substantial scan angles. These results demonstrate the feasibility and practicality of the basic concept.Author (GRA)

N77-27298# Syracuse Univ., N. Y.
POINT SOURCE RADIATION PATTERN SYNTHESIS BY ITERATIVE TECHNIQUES
Jose Perini and Jason Chou Feb. 1977 40 p refs
(Contract F30602-75-C-0121)
(AD-A038790; RADC-TR-77-33) Avail: NTIS
HC A03/MF A01 CSCL 09/5

The steepest descent method has been applied to the radiation pattern synthesis of a planar array. The error function is defined as the difference between the specified pattern and the radiation pattern over the entire synthesis range. The steepest descent technique is used to find the new array parameters such that the error function is a minimum. Synthesis examples and a computer program implementation of the method are presented in the report. Author (GRA)

N77-27299# Syracuse Univ., N. Y. Dept. of Electrical and Computer Engineering.
ANTENNA PATTERN DISTORTION COMPUTER PROGRAM
Jose Perini and Kazuhiro Hirasawa Oct. 1977 69 p refs
(Contract F30602-75-C-0121)
(AD-A038142; RADC-TR-77-35) Avail: NTIS
HC A04/MF A01 CSCL 09/5

The Antenna Pattern Distortion Computer Program is a user oriented code that allows the engineer designing a communication antenna farm to easily enter the antennas involved by simply calling their AF number (AT1181, AT1097, AT197, and a lightning rod LR1000) and specifying their location on an arbitrary reference plane. This reformer plane may be specified as a perfectly conducting infinite ground plane if desired. The program output may be any specified horizontal or vertical pattern. It can also calculate the mutual coupling between any two antennas. If the information provided by the AFCS SCREEN is available, the program can provide plots of the communication range of station when the antenna pattern, antenna power, terrain topography, and receiver sensitivity are specified for any specified aircraft altitude. Author (GRA)

N77-27300# Michigan Univ., Ann Arbor. Cooley Electronics Lab.
BCSG-76 SIGNAL SOURCE DOCUMENTATION
Kurt Metzger and L. Wayne VonWald Mar. 1977 41 p
(Contract N00014-75-C-0175)
(AD-A038395; CEL-TM-114; Rept-013376-4-M) Avail: NTIS
HC A03/MF A01 CSCL 20/1

This memo serves to document the design and operation of the BCSG-76 signal source. This unit is the latest in a series of signal sources designed and constructed at Cooley Electronics Laboratory for use in performing acoustic propagation studies. Author (GRA)

N77-27301# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
MULTIPATH DISPERSION IN LOW VISIBILITY OPTICAL COMMUNICATION CHANNELS Final Report, 1 Jul. 1975 - 30 Sep. 1976
R. S. Kennedy and J. H. Shapiro Feb. 1977 90 p refs
(Contract F19628-76-C-0054)
(AD-A038870; RADC-TR-77-73) Avail: NTIS
HC A05/MF A01 CSCL 17/2

The potential for optical communication through low-visibility scattering atmospheres is the underlying concern of this investigation. To access that potential, the effects of the channel upon the optical signal propagating through it must be determined. The work reported here is primarily concerned with one of those effects: the time dispersion, or multipath spread, of the transmitted signal. The investigation was primarily an experimental one, utilizing the existing propagation facility operating over a thirteen kilometer experimental path between the MIT campus and a field station located at an Air Force site in suburban Boston. Experiments were performed at visible and near infrared wavelengths, with highly collimated transmitting beams. Measurements of the multipath spread for various receiver fields of view, and at various off-axis angles were made. Little multipath and angular spread were observed within the realm of atmospheric conditions for which a detectable signal could be obtained. For optical thicknesses less than ten, the on-axis measurements are consistent with the hypothesis that the received signal is dominated by unscattered radiation; however, the off-axis measrements suggest that the scattered field itself may be only slightly spread in time and angle. Guided by the observed narrowness of the angular spectrum, an approximation to the linear transport equation was developed. The resulting equation is more amenable to solution than is the full transport equation. Here it is solved for isotropic scatter. For such scattering it is found that substantial spreading in both time and angle will occur when the optical thickness becomes appreciably greater than one. GRA

N77-27302# Rome Air Development Center, Griffiss AFB, N.Y.
DCA DIGITAL SYSTEMS EVALUATION. PHASE 1: MICROWAVE DIGITAL DATA TRANSMISSION Final Report
Frederick D. Schmandt Feb. 1977 164 p refs
(AD-A038607; RADC-TR-76-358) Avail: NTIS
HC A08/MF A01 CSCL 17/2

This report presents an in-depth experimental analysis of the transmission of high-quality digital traffic using an FDM type microwave radio system. After describing the equipments and test facility, the area is investigated from the point of the microwave modem's modulator to its demodulator. This establishes the basic capabilities and limitations entailed in the passing of digital traffic in the FDM radio system environment. Then performance parameters are obtained for typical digital systems configurations to be expected within the terrestrial DCS. A comparison of results evidences any degradation caused by the digital equipments. The overall emphasis is on determining what can be done with existing equipments and forming a foundation for overcoming existing technological deficiencies rather than on developing optimized systems. Author (GRA)

N77-27303# Rome Air Development Center, Griffiss AFB, N.Y.
INVESTIGATION OF AIRCRAFT GENERATED VLF INTERFERENCE
Wayne Bonser and Anthony J. Mlinar Feb. 1977 28 p
(AD-A038300; RADC-TM-76-15) Avail: NTIS
HC A03/MF A01 CSCL 17/2

Reception distances of VLF/LF transmissions, on board the KC-135 aircraft, have been severely restricted by electromagnetic interference generated by the aircraft's equipment. This interference has prevented the accurate measurement of propagation data at distances greater than 1,000 miles when using the aircraft's omnidirectional antenna. With the use of a directional loop antenna mounted on the aircraft's boom, reception distances of up to 6,000 miles have been attained. The restriction of directionality prevents measurements along paths which are of great importance to the MEECN. The reduction of aircraft interference for VLF/LF reception is of paramount importance to the Air Force and the success of this segment of the Tri Service Propagation Program is also important. This report describes the investigation of the VLF aircraft generated interference by RADC giving the characteristics of the noise in both the frequency and time domains. Author (GRA)

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N77-27304 Kansas Univ., Lawrence.
CHARGE STORAGE PROPERTIES OF THE METAL TANTALUM OXIDE-SILICON DIOXIDE-SILICON (MTOS) Ph.D. Thesis
Rodney Lee Angle 1976 198 p
Avail: Univ. Microfilms Order No. 77-2184

The characteristics of tantalum oxide and the tantalum oxide/silicon dioxide system as they apply to charge storage devices were investigated. Both anodic and thermally grown Ta_2O_5 were studied. The conduction properties of both are shown to follow a Poole Frenkel mechanism. Capacitance voltage measurements show a negative Qss with values smaller than those in comparable metal-silicon nitride-silicon dioxide-silicon (MNOS) devices. The theoretical and experimental charge storage properties of MTOS devices are shown to be in good agreement and compare favorably with MNOS devices. Finally, the threshold voltage of the MTOS device can be shifted using lower gate voltages than are needed for a comparable MNOS device. It thus appears that the MTOS device has some decided advantages over the MNOS structure as a non volatile memory element. Dissert. Abstr.

N77-27305 Iowa Univ., Iowa City.
TOTALLY-SELF-CHECKING CHECK CIRCUITS FOR SEPARABLE CODES Ph.D. Thesis
Mohammad Javad Ashjaee 1976 134 p
Avail: Univ. Microfilms Order No. 77-3711

The design of Totally Self Checking (TSC) checkers for separate codes is studied. Assuming a specific checker design, called Type I checker, a sufficient condition on separable codes is derived such that the Type I checker is TSC. Totally Self Checking Type I checkers for low cost residue codes, check sum codes and a class of Berger codes are given. A class of codes equivalent to Berger codes, called modified Berger codes, is derived for which the Type I checker is TSC, and some properties of these modified codes are proved. It is shown that the TSC Type I checkers for Berger codes and modified Berger codes have a minimal test set with very small number of tests, and an algorithm is given for a construction of a minimal test set. Dissert. Abstr.

N77-27306*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE SOLID STATE REMOTE POWER CONTROLLER: ITS STATUS, USE AND PERSPECTIVE
G. R. Sundberg and W. W. Billings (Westinghouse Electric Corp., Lima, Ohio) 1977 13 p refs Presented at 1977 Power Elec. Specialists Conf., Palo Alto, Calif., 14-16 Jun. 1977, sponsored by IEEE
(NASA-TM-73695; E-9231) Avail: NTIS HC A02/MF A01 CSCL 09C

Solid state remote power controllers (RPC's) are now available to control and protect all types of loads in both ac and dc power distribution systems. RPC's possess many outstanding qualities that make them attractive for most system applications. A review is given of the present state-of-the-art and applications for solid state RPC's for both aerospace and terrestrial systems. Author

N77-27307*# Johns Hopkins Univ., Baltimore, Md. Dept. of Electrical Engineering.
INTERMITTENT/TRANSIENT FAULT PHENOMENA IN DIGITAL SYSTEMS Final Report
Gerald M. Masson Jul. 1977 112 p refs
(Grant NsG-1265)
(NASA-CR-153743) Avail: NTIS HC A06/MF A01 CSCL 09C

An overview of the intermittent/transient (IT) fault study is presented. An interval survivability evaluation of digital systems for IT faults is discussed along with a method for detecting and diagnosing IT faults in digital systems. Author

N77-27308*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MULTILEVEL METALLIZATION METHOD FOR FABRICATING A METAL OXIDE SEMICONDUCTOR DEVICE Patent Application
Ben R. Hollis, Jr., William R. Feltner, Donald E. Routh, and David L. Boulden, inventors (to NASA) Filed 8 Jul. 1977 20 p
(NASA-Case-MFS-23541-1; US-Patent-Appl-SN-814005) Avail: NTIS HC A02/MF A01 CSCL 09A

An improved method of constructing a metal oxide semiconductor (MOS) device having multiple layers of metal deposited by dc magnetron sputtering at low dc voltages and low substrate temperatures is described. Multilevel interconnections and cross over between individual circuit elements in integrated circuits are constructed without significantly reducing the reliability or seriously affecting the yield. NASA

N77-27309*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PERFORMANCE CHARACTERISTICS OF THREE-PHASE INDUCTION MOTORS
Marion E. Wood May 1977 40 p refs
(NASA-TM-74762; JSC-12899) Avail: NTIS HC A03/MF A01 CSCL 09A

An investigation into the characteristics of three phase, 400 Hz, induction motors of the general type used on aircraft and spacecraft is summarized. Results of laboratory tests are presented and compared with results from a computer program. Representative motors were both tested and simulated under nominal conditions as well as off nominal conditions of temperature, frequency, voltage magnitude, and voltage balance. Good correlation was achieved between simulated and laboratory results. The primary purpose of the program was to verify the simulation accuracy of the computer program, which in turn will be used as an analytical tool to support the shuttle orbiter. Author

N77-27310# California Univ., Livermore. Lawrence Livermore Lab.
LAYOUT SYSTEM FOR PRINTED CIRCUIT BOARDS
R. J. Smith, II 22 Sep. 1976 5 p refs Presented at the 1976 Asilomar Conf. on Circuits, Systems, and Computers, Pacific Grove, Calif., 22-24 Nov. 1976
(Contract W-7405-eng-48)
(UCRL-78563-Rev-1; Conf-760934-4) Avail: NTIS HC A02/MF A01

A computer-aided printed circuit board layout system which is now being used to produce a variety of PC board designs is described. The system is able to handle boards with arbitrary trimline geometries having up to about 100 IC's. It was designed to achieve 90-95 percent automatic connection rates on two layer boards, and has also been used to produce four layer boards. ERA

N77-27311# Los Alamos Scientific Lab., N. Mex.
DESIGN OF MULTIFILAMENTARY Nb3Sn SUPERCONDUCTOR TAILORED TO THE REQUIREMENTS OF A DC SUPERCONDUCTING POWER TRANSMISSION LINE
H. L. Laquer 1976 13 p refs Presented at ASM Conf. on Manuf. of Superconducting Materials, Port Chester, N. Y., 8 Nov. 1976
(Contract W-7405-eng-36)
(LA-UR-77-99) Avail: NTIS HC A02/MF A01

There are at least four fundamentally different layouts for Cu-stabilized multifilamentary Nb3Sn superconductors. Multiple stacking further increases the possible permutations and combinations. The basic designs with respect to compound formation, stability, reduction of current transfer resistances, flexibility, and wire strain are analyzed. As a result, a very limited number of geometries for the conductor that will be suitable for use in the subcables of a dc superconducting power transmission line operating in the 10 to 14 K range and at the relatively low self-fields of 0.2 to 0.6 T are specified. ERA

N77-27312# Sandia Labs., Albuquerque, N. Mex.
THE 275 DEG C MICROCIRCUITRY: RESISTORS, CAPACITORS, CONDUCTORS, SUBSTRATES, AND BONDING
David W. Palmer and Glen L. Knauss Dec. 1976 60 p refs
(Contract E(29-1)-789)
(SAND-76-0611) Avail: NTIS HC A04/MF A01

Commercially available resistors, capacitors, substrates, conductors, and bonding techniques were tested over the temperature range of 25-300 C. Thick film resistors were found to have a total change in resistance of 1-5% from 25-300 C, and a resistance drift of less than 1% during 1,000 hours at 300 C. Several types of capacitors were found that showed total capacitance change from 25 to 300 C of about 5%, high temperature dissipation factors of less than 10%, 300 C insulation resistances of 10 megohm-microfarad, and high temperature lifetimes greater than 1,000 hours. Polyimide board with Ni plated Cu cladding, and alumina ceramic with thick film Pt-Au conductor paths were shown to be suitable for high temperature microcircuit frameworks. ERA

N77-27313# Sandia Labs., Albuquerque, N. Mex.
FLUX REMOVAL FROM HYBRID MICROCIRCUITS AS IT AFFECTS IC'S AND DIODES
Gerrit J. Hof, Lewis K. Jones, and Frank W. Oswalt Nov. 1976 24 p ref
(Contract EY-76-C-04-0789)
(SAND-76-0599) Avail: NTIS HC A02/MF A01

There is concern for complete solder flux removal from beneath beam leaded IC's and diodes, and for the effect of the required cleaning solutions on these devices bonded to thin film circuitry on ceramic substrates. Repeated cycles of the application of flux, the application of heat as in soldering, the application of a cleaning procedure designed for complete flux removal, and electrical testing were studied. The devices were bonded to headers to facilitate handling and testing. The cleaning procedures used removed flux from beneath these particular devices. ERA

N77-27314# Sandia Labs., Albuquerque, N. Mex. Surface Metallurgy Div.
SURFACE CONTAMINANT CHARACTERIZATION USING POTENTIAL-CURRENT CURVES
R. E. Cuthrell and L. K. Jones Nov. 1976 16 p
(Contract E(29-1)-789)
(SAND-76-0623) Avail: NTIS HC A02/MF A01

Potential-current curves were investigated for the characterization of contaminants on electrical contact surfaces. Pronounced leveling of the potential (decreasing contact resistance) occurs as the junction temperature is raised through the melting temperature of the contaminants. Thus the characteristics shape of potential-current curves may be used to distinguish between low and high melting organic contaminants and between these and oxides or refractory particles. This in situ diagnostic test has found recent industrial application in the manufacture of sensitive switches. ERA

N77-27315# Sandia Labs., Albuquerque, N. Mex.
INTEGRATED CIRCUIT DESIGN USING DESIGN AUTOMATION
Charles W. Gwyn Sep. 1976 12 p refs Presented at SCIE Tech. Meeting, Denver, 30 Sep. 1976
(Contract E(29-1)-789)
(SAND-76-0572; Conf-760979-1) Avail: NTIS HC A02/MF A01

The advantages of using computers in the design and fabrication of integrated circuits are discussed. Custom IC's have been developed in much shorter times than available through semiconductor device manufacturers. Security problems were minimized, and a saving was realized in circuit cost. The custom CMOS IC's were designed at less than half the cost of designing with conventional techniques. In addition to the computer aided design, the prototype fabrication and testing capability provided by the semiconductor development laboratory and microelectronics computer network allows the circuits to be fabricated and evaluated before the designs are transferred to the commercial semiconductor manufacturers for production. The Sandia design and prototype fabrication facilities provide the capability of complete custom integrated circuit development entirely within the ERDA laboratories. ERA

N77-27316# Gordian Associates, Inc., New York.
STRUCTURAL REFORM IN THE ELECTRIC POWER INDUSTRY Final Report
Feb. 1977 97 p refs
(Contract FEA-CO-05-50152-00)
(PB-264589/3; FEA/G-76/323) Avail: NTIS HC A05/MF A01 CSCL 13B

The long-term capability of the electric power industry and its associated regulatory institutions to operate efficiently and effectively under a wide range of possible demand conditions is investigated. GRA

N77-27317# Harry Diamond Labs., Adelphi, Md.
HYBRID INTEGRATED CIRCUITS: A SURVEY
Philip Ingersoll Jan. 1977 13 p
(AD-A038010; HDL-TR-1790) Avail: NTIS HC A02/MF A01 CSCL 09/5

Two proximity fuzes under development at the Harry Diamond Laboratories use thick-film hybrid integrated circuits. A survey of the hybrid integrated circuit industry was conducted to determine its capability to produce these circuits in volume within the continental United States. The circuits as complex as those used in XM587 and XM734 fuzes are in volume production using certain types of automation. Author (GRA)

N77-27318# Raytheon Co., Bedford, Mass. Missile Systems Div.
SYNTHESIS OF PLANE STRATIFIED DIELECTRIC SLAB SPATIAL FILTERS USING NUMERICAL OPTIMIZATION TECHNIQUES Final Report, 1 Apr. - 30 Sep. 1976
J. H. Pozgay, S. Zamoscianyk, and L. R. Lewis Griffiss AFB, N. Y. RADC Dec. 1976 106 p refs
(Contract F19628-76-C-0189)
(AD-A037960; BR-9389; RADC-TR-76-408) Avail: NTIS HC A06/MF A01 CSCL 09/5

The synthesis of plane stratified dielectric slab spatial filters using numerical optimization techniques is presented. The stratified dielectric slab spatial filter is a unique concept for element pattern control on large planar arrays in that it gives protection for the array in the fashion of a radome. However, because of the relatively limited number of low loss microwave dielectrics, the synthesis of practical spatial filters must proceed in a manner which guarantees that the final configuration consists of materials which are readily available and reproducible. A numerical optimization technique of stratified dielectric filter synthesis has been developed which provides this guarantee while simultaneously attaining the required spatial and frequency bandwidth response. Using the optimization technique, an eleven layer filter design for use with a large mechanically scanned array has been obtained which has greater than 10 db rejection in an angular stopband of 36 deg and less than 0.3 db transmission loss in an angular passband of 10 deg around broadside. An up to date tabulation of available low loss microwave dielectrics and complete computer program listings are given in the Appendices. Author (GRA)

N77-27319# Yucca International, Inc., Scottsdale, Ariz.
DEVELOPMENT OF AN INTEGRATED MODULE REGULATED VOLTAGE SUPPLY Final Report
Feb. 1977 28 p
(Contract DAAG53-76-C-0035)
(AD-A037049) Avail: NTIS HC A03/MF A01 CSCL 10/2

The principal performance requirements for solid state power conditioners are generally derived from inherent performance capabilities of mobile electric power engine-generator sets. They are embodied in MIL STD 1332 and in specifications for uninterruptable power supplies. In these specifications the criteria for frequency stability was originally linked to engine speed control assuming a directly coupled generator. Frequency stability for solid state power conditioners can easily be upgraded without significant design penalty. However, an equipment operating mode at high voltage and a short term current overload capacity of 200%, increases cost because of a greater equipment complexity and higher component kVA requirements. Many output voltage ratings for solid state power conditioners are not

necessarily based on a mandatory performance requirement of mobile power stations, but apply mainly to the inherent means for reconnecting the generator's armature windings either in parallel or in series, and apply also to the manipulation of the magnetic flux of the machine to obtain either a 120-160 V RMS, 208-277 V RMS or a 416-480 V RMS rating. GRA

N77-27320# Syracuse Univ., N. Y.
SYSTEM MODULARIZATION TO MINIMIZE LIFE CYCLE COSTS Final Technical Report, Aug. 1975 - Jul. 1976
John E. Biegel and Bisrat Bulcha Griffiss AFB, N. Y. RADC Jan. 1977 51 p refs
(Contract F30602-71-C-0312)
(AD-A036868; RADC-TR-77-13) Avail: NTIS HC A04/MF A01 CSCL 09/3

When designing equipments, particularly electronic equipments, there is a need to collect components into integral groups called modules. A network can be arbitrarily decomposed into modules, but an optimum modularization would minimize the life cycle cost (LCC) of the system. This research was directed toward that goal. The method developed is a heuristic, and no attempt has been made to establish its optimality (although no counter examples are known). The problem is approached as one of decomposing a network subject to constraints. The problem may be stated as: Decompose a system to minimize the life cycle cost subject to physical constraints, a mean-time-to-repair constraint and establish spares to meet an availability constraint. A computer routine has been developed and explained. A flow chart is included. Author (GRA)

N77-27321# EIMAC, San Carlos, Calif.
MANUFACTURING METHODS AND TECHNOLOGY (MMTE) MEASURE FOR FABRICATION OF LOW VOLTAGE START SEALED BEAM ARC LAMPS Quarterly Progress Report, 1 Sep. - 30 Nov. 1976
Edwin Chan and Tim Bell 29 Dec. 1976 30 p
(Contract DAAB07-76-C-0034)
(AD-A037751; EIMAC-QPR-76-2) Avail: NTIS HC A03/MF A01 CSCL 13/1

A program is in progress to establish a production capability for the purpose of meeting estimated military needs for the X6335, a 1kW sealed beam xenon arc lamp with low voltage starting mechanism. In accordance with the requirements of the contract, the first engineering sample lamp was delivered. A modification was made in the structual design of the second engineering sample to correct a dimension problem on the first engineering sample. Additional refinements have been implemented to the Second Engineering Sample for test and evaluation. A test device 'Driving Circuit Test Device' was designed and fabricated for testing of lamp burn-in and lamp ignition requirements. This test device will aid in achieving the specified requirements. Author (GRA)

N77-27322# Westinghouse Electric Corp., Horseheads, N. Y. Industry and Government Tube Div.
MANUFACTURING METHODS AND ENGINEERING FOR TFT ADDRESSED DISPLAY Quarterly Report, 7 May - 6 Aug. 1976
R. G. Abraham, T. Csakvary, D. H. Davies, M. Green, and W. L. Rogers Oct. 1976 85 p refs
(Contract DAAB07-76-C-0027)
(AD-A037100) Avail: NTIS HC A05/MF A01 CSCL 09/5

This is the first quarterly report on manufacturing methods and technology evaluation for the fabrication of a thin film transistor based solid state display panel. A description is given of the theory of operation of a thin film transistor electroluminescent display and of the mechanical and electrical characteristics of the specific 256 character alphanumeric device to be manufactured under the subject contract. The anticipated performance of the display is reviewed, and the fabrication techniques to be used for the TFT circuit, phosphor deposition and display packaging are discussed in detail. Work has commenced both on the fabrication of Engineering Samples and the preparation of the Pilot Manufacturing Facility for display circuit fabrication. In the Engineering Samples area a complete mask set has been assembled, and circuit depositions are in progress. Some unexpected difficulties have been encountered with overheating of masks, but, despite these problems, display circuits have been built containing transistors with excellent electrical performance characteristics. Magnetic pull-up equipment has been designed and constructed. This is required to ensure good contact between mask and substrate during circuit depositions. The equipment has been tested successfully, both in the Engineering Samples system and in the Pilot Manufacturing Facility. GRA

N77-27323# Army Electronics Command, Fort Monmouth, N. J. Electronics Technology and Devices Lab.
SPRAY DRIED FERRITE POWDERS FOR ARC PLASMA SPRAYING Technical Report, Jan. - Dec. 1976
Janina J. Mitchell Feb. 1977 17 p refs
(DA Proj. 1L7-62705-AH-94)
(AD-A037181; ECOM-4472) Avail: NTIS HC A02/MF A01 CSCL 20/9

The physical characteristics of spray dried lithium ferrite powders to be used in the arc plasma spraying process are discussed. The effects of spray dry parameter changes on the flow characteristics, average size and size distribution of the spherical agglomerates produced by this process, are established. Also established are the relationships between these spray dried lithium ferrite powder characteristics and the magnetic properties of the bulk lithium ferrite produced by arc plasma spraying. Author (GRA)

N77-27324# General Electric Co., Pittsfield, Mass. Ordnance Systems.
DIGITAL MICROCIRCUIT CHARACTERIZATION AND SPECIFICATION Final Technical Report, Apr. 1975 - Dec. 1976
Thomas M. Ostrowski Mar. 1977 264 p
(Contract F30602-74-C-0159)
(AD-A038969; RADC-TR-77-91) Avail: NTIS HC A12/MF A01 CSCL 09/5

The objective of this effort was to generate MIL-M-38510 slash sheets for microprocessor integrated circuits. The report includes the general microprocessor test philosophy developed and used, technical analyses of manufacturer generated functional test programs, changes made to manufacturer programs, and the approach taken in slash sheet development. Two slash sheets were developed /400 for the 6,800 and /420 for the 8080A microprocessor 'not included in the report'. Also included are analyses of functional tests for many lower power Schottky flip flops and one CMOS register circuit CD4035A. Author (GRA)

N77-27325# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
SMALL-SIGNAL THIRD-ORDER DISTORTION ANALYSIS OF TRANSISTOR AMPLIFIERS
J. Daniel Cobb Dec. 1976 45 p refs
(Contract DAAB07-72-C-0259; Grant NSF ENG-75-02708)
(AD-A038270; R-751; UILU-ENG-76-2239) Avail: NTIS HC A03/MF A01 CSCL 09/5

When a sinusoidal signal is applied to a nonlinear system, the signals which result internally and at the output of the system can, in the steady state, be decomposed into a sum of sinusoids whose frequencies are various integer multiples of the frequency of the input signal. That component which has frequency three times the frequency of the input signal is commonly referred to as third order distortion. Author (GRA)

N77-27326# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
HELIUM RESEARCH IN SUPPORT OF SUPERCONDUCTING POWER TRANSMISSION Annual Report, Jul. 1975 - Sep. 1976
M. C. Jones, V. D. Arp, W. R. Parrish, D. E. Daney, and P. R. Ludtke Feb. 1977 100 p refs
(Contract E(49-1)-3800)
(PB-265076/0; NBSIR-77-853; CONS-3800-1car-2) Avail: NTIS HC A05/MF A01 CSCL 09C

Results are presented from experimental and computer modeling of the performance of current leads cooled with supercritical helium gas. Performance characteristics studied are burn-out conditions and existence of oscillation in the helium gas. Conclusions are given on the feasibility of data transmission from high voltage regions to grounded read-out instrumentation,

on thermometry, and on helium impurity measurements. Test results of microwave cavity pressure transducers for use at helium temperatures are discussed along with computer codes for helium properties and data on the thermal conductivity or helium. A flow facility built for research on flow and heat transfer dynamics of supercritical helium in channels of high aspect ratio modeling superconducting power transmission line channels is described. GRA

N77-27327# National Bureau of Standards, Boulder, Colo. Time and Frequency Div.

QUARTZ CRYSTAL OSCILLATORS WITH LOW ACCELERATION SENSITIVITY

J. J. Gagnepain and F. L. Walls Mar. 1977 17 p
(PB-265075/2; NBSIR-77-855) Avail: NTIS HC A02/MF A01 CSCL 09A

The acceleration sensitivity of quartz crystal resonators imposes severe limitations on their use in nonlaboratory environments. It is shown that by using two resonators connected in series and properly orientated with respect to one another, it is possible to substantially reduce the net acceleration sensitivity of the composite or compound crystal resonator. First qualitative experimental results on acceleration, also some experimental theories of studies related to the introduction of the two resonators comprising the compound resonator, are presented. From these studies it appears feasible to fabricate compound crystal resonators exhibiting acceleration sensitivities at least 10 times smaller than the resonators used individually. GRA

N77-27328# RCA Labs., Princeton, N. J.

SEMICONDUCTOR MEASUREMENT TECHNOLOGY: TECHNIQUES FOR MEASURING THE INTEGRITY OF PASSIVATION OVERCOATS ON INTEGRATED CIRCUITS Final Report, 24 Apr. 1975 - 30 Apr. 7976

Werner Kern and Robert B. Comizzoli Mar. 1977 124 p refs
(Contract NBS-5-35913; ARPA Order 2397)
(PB-264939/0; NBS-SP-400-31; LC-76-608229) Avail: NTIS HC A06/MF A01 CSCL 09E

Conventional test methods to evaluate the quality of glass passivation overcoats on semiconductor devices are generally inadequate and/or destructive. Three methods were devised that overcame these problems: (1) Sequential selective chemical etching of metal dielectric structures to detect buried, latent, or partial defects as a function of dielectric layer depth, (2) Electrophoretic cell decoration with UV phosphor particles suspended in an insulating liquid, the sample forming one electrode of the cell, and (3) Electrostatic corona charging to selectively deposit surface ions from a high voltage dc discharge on the insulating surfaces of the sample, followed by placing of the charged sample in a suspension of charged carbon black particles in an insulating liquid. GRA

N77-27329# National Bureau of Standards, Washington, D. C.

SEMICONDUCTOR MEASUREMENT TECHNOLOGY: NOTES ON SEM (SCANNING ELECTRON MICROSCOPE) EXAMINATION OF MICROELECTRONIC DEVICES Summary Report

John R. Devaney (Hi-Rel Labs.), K. O. Leedy, and W. J. Keery Apr. 1977 56 p refs
(Contract NBS-4-35897; ARPA Order 2397)
(PB-264929/1; NBS-SP-400-35) Avail: NTIS HC A04/MF A01 CSCL 09A

Selected scanning electron microscope (SEM) techniques which are appropriate for the examination of microelectronic devices are reviewed. Illustrated are the results of individual variations in SEM operating parameters such as accelerating voltage, specimen tilt, scan line time, and frame time. Techniques which use secondary and backscattered electron emissions are compared and electron beam induced current and voltage contrast modes are discussed. Specimen preparation and beam induced charging artifacts are also discussed. The need for flexibility in selecting and using SEM parameters and analytic procedures to obtain the maximum information when examining semiconductor devices is demonstrated. GRA

N77-27330# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.

APPLICATIONS OF MULTICONDUCTOR TRANSMISSION LINE THEORY TO THE PREDICTION OF CABLE COUPLING. VOLUME 3: PREDICTION OF CROSSTALK IN RANDOM CABLE BUNDLES Final Report

Clayton R. Paul Feb. 1977 113 p refs
(Contract F30602-75-C-0118)
(AD-A038316; RADC-TR-76-101-Vol-3) Avail: NTIS HC A06/MF A01 CSCL 09/1

Random cable bundles as described in this report are groups of wires (cylindrical conductors) in which the relative wire positions are unknown and vary in some uncontrolled fashion along the cable length. These cable bundles result from the need to contain wires connecting electronic equipments in compact groups. Current practice in the avionics industry is to group wires into these random bundles although the use of ribbon cables (in which wire position is carefully controlled) is increasing. These random bundles can be quite large, and no attempt is made to control the relative wire positions within the bundle. Wire-coupled interference (crosstalk) in cable bundles results from the unintentional coupling of signals from one circuit into another by virtue of the electromagnetic interaction between wires in the same cable bundle. The ability to predict this crosstalk is obviously quite important in determining overall system compatibility, i.e., will the system performance be degraded to an intolerable level by this interference. GRA

N77-27331# Army Electronics Command, Fort Monmouth, N. J.

REPETITIVE SERIES INTERRUPTER

Maurice Weiner Feb. 1977 24 p refs
(AD-A038545; ECOM-4469) Avail: NTIS HC A02/MF A01 CSCL 09/5

This work describes a novel approach for the protection of high power microwave tubes against arcs. The protective device is basically an electronically resettable fuse which is placed in series in the discharge circuit. Upon the sensing of an arc, the device interrupts the current until the arc clears. This permits operation on the next pulse. The device consists of a thyratron with a long discharge region in series with a perforated anode. Current interruption is achieved by the application of a pulsed magnetic field in the interaction region to vary the impedance of the discharge. Results of the investigation demonstrate overall feasibility and point out areas requiring further development. Author (GRA)

N77-27332# Army Electronics Command, Fort Monmouth, N. J.

CONSTANT CURRENT CHARGING CIRCUITS FOR HIGH ENERGY MODULATORS

John L. Carter Feb. 1977 20 p
(AD-A038546; ECOM-4471) Avail: NTIS HC A02/MF A01 CSCL 09/5

A technique to achieve square wave charging of the pulse forming networks in a line type pulser has been investigated. The proposed circuit uses parallel PFNs with charging inductors connected between PFNs. The charging network pulse width equals the interpulse time for the pulser. Experimental and computer data is presented for the circuit. Author (GRA)

N77-27333# Army Electronics Command, Fort Monmouth, N. J.

MEGAWATT AVERAGE POWER ADIABATIC MODE THYRATRONS

John E. Creedon and Sol Schneider Apr. 1977 10 p
(AD-A039045; ECOM-4488) Avail: NTIS HC A02/MF A01 CSCL 09/1

Significant impact on the size and weight of high energy pulse systems having short on-times can be obtained by designing components to operate in the adiabatic mode. In the specific case of the thyratron switch, the mass of the cathode anode and grid elements can be used as internal heat sinks. This allows the average current capability and thus the power handling ability to be increased several times over the normal steady state value for short operating times. Several thyratrons designed for short term, high peak, and average power switching applications have been studied at average powers approaching one megawatt. In addition, an off-the-shelf HY-5 was operated in the adiabatic mode, and it was found that by modifying the cathode structure,

the device was capable of being operated reliably at 22.5 amperes of average current at a peak voltage of 15 kilovolts.
Author (GRA)

N77-27334# General Electric Co., Schenectady, N.Y.
PROTECTIVE COAXIAL SWITCHING DEVICES Semiannual Technical Report, 15 Jun. - 14 Dec. 1976
L. M. Levenson, H. R. Philipp, and G. A. Slack Mar. 1977 58 p refs
(Contract DAAB07-76-C-1331)
(AD-A038087; SRD-77-047; ECOM-76-1331-1) Avail: NTIS HC A04/MF A01 CSCL 09/5

The use and performance of NbO/NbO2 chips supplied by ECOM in a coaxial switching device have been investigated. The material does exhibit switching with a delay time of less than 1 ns. The threshold switching voltage is typically 100 to 300 V. A manufacturable packaging configuration with evaporated small area contacts has been developed and fifty (50) completed devices have been supplied. Step by step details of all pertinent fabrication procedures, from selection of as received chips to final mounting and wire bonding of the completed unit, are described. Device stability for a range of pulse lengths has also been investigated and is discussed in some detail. The electrical parameters of the as supplied chips do not, however meet the specifications listed in the Technical Guidelines DAAB07-76-Q-1335 which require a threshold switching voltage -100. In addition, device degradation with repeated pulsing is observable even for 3 ns pulse widths and is markedly accelerated for larger pulse widths. Author (GRA)

N77-27335# Honeywell, Inc., Golden Valley, Minn. Ceramics Center.
MANUFACTURING METHODS AND TECHNIQUES FOR PIEZOELECTRIC ENGINEERING MEASURE (PEM) Quarterly Progress Report, 14 Jul. - 14 Oct. 1976
William B. Harrison, L. Hiltner, and W. Kammeyer 14 Oct. 1976 47 p refs
(Contract DAAB07-76-C-0008)
(AD-A039043; Honeywell-46585; QPR-5) Avail: NTIS HC A03/MF A01 CSCL 09/1

The Fifth Quarterly Report for Contract DAAB07-76-C-0008 describes the progress and status of this program to establish a cost-effective production capability for 18 mm and 25 mm piezoelectric ceramic transformers. Based on the low efficiency of the 18 mm PETS a review of the 18 mm design was conducted, and three additional first engineering samples were built and evaluated. Test results on these samples and a revised specification are presented in this report. Author (GRA)

N77-27336# Illinois Univ., Urbana-Champaign. Electromagnetics Lab.
INVESTIGATION OF INTEGRATED CIRCUITS, OPTICAL PROCESSING, AND RADAR SCANNING PROBLEMS Final Report, 1 Feb. 1974 - 31 Jan. 1977
Raj Mittra 31 Jan. 1977 57 p refs
(Grant DAHC04-74-G-0113)
(AD-A038185; UIEL-77-4; UILU-ENG-77-2545; ARO-12049.10-EL) Avail: NTIS HC A04/MF A01 CSCL 09/5

During the past three years a rather broad array of topics that include microwave and quasi-optical integrated circuits, coherent optics, and the applications of numerical and asymptotic techniques to radar scattering and antenna problems have been investigated. Some of the important accomplishments in these areas are described, and the scientific publications describing the research results are listed. GRA

N77-27337# Microwave Associates, Inc., Burlington, Mass.
MM AND T PROGRAM FOR THE ESTABLISHMENT OF PRODUCTION TECHNIQUES FOR HIGH POWER BULK SEMICONDUCTOR LIMITERS Quarterly Report, 23 Jun. - 22 Sep. 1976
Y. Anand, P. Bakeman, and R. Bilotta Nov. 1976 85 p refs
(Contract DAAB07-76-C-0039)
(AD-A038285; ECOM-00039-1-76; QR-1) Avail: NTIS HC A05/MF A01 CSCL 09/5

The objective of this Manufacturing Methods and Technology Engineering Program is to establish the producibility of the X-band semiconductor bulk limiter and the X-band bulk semiconductor - lower diode multistage limiter by mass production techniques. During the quarter, X-band semiconductor bulk limiters and multistage clean up limiters were manufactured and were characterized for their RF performance. First engineering samples (Item 0001AA) consisting of five bulk limiters and one clean up limiter will be shipped on schedule. Author (GRA)

N77-27338# R and D Associates, Marina Del Rey, Calif.
PROBABILITY DISTRIBUTION OF CW INDUCED CURRENTS ON RANDOMLY ORIENTED SUB-RESONANT LOOPS AND WIRES
William R. Graham and Charles T. C. Mo May 1976 68 p refs
(Contract DNA001-76-C-001)
(AD-A038720; DNA-4162T) Avail: NTIS HC A04/MF A01 CSCL 09/3

The deterministic prediction of both transient and CW field coupling to large complex electrical systems poses such a formidable problem that other approaches to predicting the coupling may be useful. In this paper, we analyze the continuous wave coupling to a complicated electrical system in terms of random small dipole interactions in the low frequency limit (wavelength system components' sizes). Both random coupling to the incident wave and random interactions among the dipoles are considered. The variables being randomized are the incident direction and polarization, the sizes and orientations of the dipoles, the mutual coupling strengths, and the lumped load impedances. The resulting normalized current distributions are shown to be insensitive to the details of the model except at the extremely low and high percentiles. GRA

N77-27339# Raytheon Co., Waltham, Mass. Special Microwave Devices.
MANUFACTURING METHODS AND TECHNOLOGY ENGINEERING HIGH EFFICIENCY, HIGH POWER GALLIUM ARSENIDE READ-TYPE IMPATT DIODES Quarterly Progress Report, 1 Jul. - 30 Sep. 1976
Henri R. Chalifour and Samuel R. Steele Oct. 1976 29 p refs
(Contract DAAB07-75-C-0045)
(AD-A038172; Rept-1176-1310; QPR-5) Avail: NTIS HC A03/MF A01 CSCL 09/5

Work on fabrication of the Confirmatory Samples was initiated. The X and Ku-band wafers were grown. The processing of dice from these wafers was begun. New equipment has been installed on the production line. A hot-gas bonding unit was installed to facilitate chip mounting. A thermal resistance tester was installed to increase production rates. Author (GRA)

N77-27340# Rockwell International Corp., Richardson, Tex. Hybrid Microelectronics Div.
A PRODUCTION ENGINEERING MEASURE FOR 2 L BAND SOLID STATE MICROWAVE FREQUENCY SOURCES Quarterly Report, 30 Aug. - 30 Nov. 1976
Jerome K. McCoy 17 Dec. 1976 80 p refs
(Contract DAAB07-76-C-0026)
(AD-A038091; QR-2) Avail: NTIS HC A05/MF A01 CSCL 09/5

This report describes the specifications and approach, and details the work completed in the design and fabrication of an L Band Radisonde Modulator/Transmitter and an L Band FM Source. Q and line definition are a few parameters that are being investigated in the thick film evaluation program. Plans have been formulated for third set of engineering samples. GRA

N77-27341# TRW, Inc., Lawndale, Calif. Semiconductor Div.
PRODUCTION ENGINEERING MEASURE FOR AN INTEGRATED CIRCUIT POWER AMPLIFIER 600-1000 MHz, FOR TACTICAL RADIO EQUIPMENT Quarterly Report, 1 Jul. - 30 Sep. 1976
Roger C. DeBloois Sep. 1976 45 p refs
(Contract DAAB05-72-C-5844)
(AD-A038104; QR-18) Avail: NTIS HC A03/MF A01 CSCL 09/5

During this period the fifty pilot run amplifiers were fabricated at the required production rate. Group A testing was completed

within the allotted time establishing that the through-put requirements were met. Author (GRA)

N77-27342# Varian Associates, Palo Alto, Calif.
INVESTIGATION OF InGaAs FETs Final Report, Nov. 1976 - Feb. 1977
R. L. Bell and S. G. Bandy Mar. 1977 50 p refs
(Contract N00014-76-C-1056)
(AD-A038821) Avail: NTIS HC A03/MF A01 CSCL 09/1

Application of the theory of Statz et al. to the noise behavior of early In GaAs FETs shows that this is due to flow of channel current in the substrate/In GaAs grading layer, where the saturated electron velocity is degraded. If this defect is eliminated, the model shows a return to GaAs-like behavior, but with significantly better noise figure than GaAs, despite possible increase in electron temperature. Author (GRA)

N77-27343# Watkins-Johnson Co., Palo Alto, Calif.
PYROLYTIC BORON NITRIDE AS A DIELECTRIC SUBSTRATE MATERIAL FOR MICROWAVE INTEGRATED CIRCUITS Final Report, 1 Jun. 1976 - 1 Apr. 1977
C. M. Krowne 1 Apr. 1977 45 p refs
(Contract N00014-76-C-0896)
(AD-A038627) Avail: NTIS HC A03/MF A01 CSCL 09/5

Quasi-TEM electromagnetic theory is developed for microstrip lines on diagonal tensor dielectric substrate materials. Computer programs based on this theory using method of moments are described and were utilized to determine the electrical parameters for single and parallel-coupled microstrip lines on the substrate material pyrolytic boron nitride (PBN). Experimental measurements for single lines on PBN and for quadrature interdigitated coupled lines on PBN are reported. GRA

N77-27344# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
THIN FILM TRANSISTOR-ADDRESSED DISPLAY DEVICE Quarterly Report, 1 Oct. - 31 Dec. 1974
Thomas P. Brody, Fang C. Luo, David H. Davies, Zoltan P. Szepesi, Edward W. Greeneich, and W. A. Hester Apr. 1977 40 p
(Contract DAAB07-72-C-0061; DA Proj. 1S7-62705-AH-94)
(AD-A038286; Rept-77-9F9-DSPLA-R1; ECOM-72-0061-10; QR-10) Avail: NTIS HC A03/MF A01 CSCL 09/5

The achievement of operational 6 x 6 inch 30 lpi dot matrix displays is reported. The addressing is accomplished using thin-film transistor matrices and the display medium is ac-electroluminescence. The panel was operational over all its area, but the quality needs to be improved before it is comparable to the near perfect 20 lpi panels fabricated. A good method for interconnecting was developed using a solder bonded PC board. Greater than 75% active lit area was achieved on several displays through a second level electroding process. Further progress towards improved defect free operation can be expected.
Author (GRA)

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N77-27345* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SYSTEM FOR MEASURING THREE FLUCTUATING VELOCITY COMPONENTS IN A TURBULENTLY FLOWING FLUID Patent
Dah Yu Cheng, inventor (to NASA) (Santa Clara Univ., Calif.) Issued 14 Jun. 1977 12 p Filed 15 Mar. 1976 Supersedes N76-19379 (14 - 10, p 1249) Sponsored by NASA
(NASA-Case-ARC-10974-1; US-Patent-4,028,939; US-Patent-Appl-SN-667010; US-Patent-Class-73-189; US-Patent-Class-73-228) Avail: US Patent Office CSCL 20D

A system is described for measuring fluid velocity in a turbulently flowing fluid including a sensing apparatus for dynamically sensing the mainstream and two orthogonal cross velocity components of the fluid. A transducer operative is included to provide three electrical output signals representative of the velocity components in the mainstream, and in the cross directions. Signal processors can be utilized to derive the Reynolds stress wave and the Reynolds stress.
Official Gazette of the U.S. Patent Office

N77-27346 Rensselaer Polytechnic Inst., Troy, N. Y.
THE EFFECTS OF HYDROSTATIC PRESSURE AND WALL ELASTICITY ON STANDING-GRADIENT (OSMOTICALLY DRIVEN) FLOW IN PHYSIOLOGICAL TUBULES Ph.D. Thesis
Christopher Chsiu Mong 1976 146 p
Avail: Univ. Microfilms Order No. 77-2832

A hydrodynamic model is developed to describe the coupled water and solute flow in a long channel with elastic walls which is closed at one end and open at the other. The governing equations take into account the elasticity of the channel wall which is stretched by hydrostatic pressure and water leakage due to hydrostatic pressure difference between the interior and exterior of the channel, at the same time retaining the one-dimensional properties used in the kinematic model of Diamond and Bossert (1967) and Segel (1970). Both numerical and analytical asymptotic solutions are presented, using ranges of parameter values which are typical in epithelia. Dissert. Abstr.

N77-27347*# Combustion, Heat and Mass Transfer Ltd., Wimbledon (England).
PREDICTION OF HYDRODYNAMICS AND CHEMISTRY OF CONFINED TURBULENT METHANE-AIR FLAMES WITH ATTENTION TO FORMATION OF OXIDES OF NITROGEN
S. Elghobashi, D. B. Spalding, and S. K. Srivatsa Mar. 1977 269 p refs
(Contract NAS3-18940)
(NASA-CR-135179; CHAM-951/2) Avail: NTIS HC A12/MF A01 CSCL 20D

A formulation of the governing partial differential equations for fluid flow and reacting chemical species in a tubular combustor is presented. A numerical procedure for the solution of the governing differential equations is described, and models for chemical equilibrium and chemical kinetics calculations are presented. The chemical equilibrium model is used to characterize the hydrocarbon reactions. The chemical kinetics model is used to predict the concentrations of the oxides of nitrogen. The combustor consists of a cylindrical duct of varying cross sections with concentric streams of gaseous fuel and air entering the duct at one end. Four sample cases with specified inlet and boundary conditions are considered, and the results are discussed Author

N77-27348*# Kanner (Leo) Associates, Redwood City, Calif.
INVESTIGATIONS OF TURBULENT GAS FLOWS BY MEANS OF THE LASER-DOPPLER ANEMOMETER AND THE LASER-CROSSED BEAM-SCHLIEREN PROCEDURE
B. Koch and H. J. Pfeifer Washington NASA May 1977 7 p Transl. into ENGLISH of Conf. Paper 76-2-03 from the German Soc. of Aeron. and Astronautics, Munich. Presented at 9th Ann. Congr., Munich, 14-16 Sep. 1976 Original language document was announced as A77-16547
(Contract NASw-2790)
(NASA-TT-F-17424; Paper-76-203) Avail: NTIS HC A02/MF A01 CSCL 20D

The velocity field and the turbulence structure of subsonic and supersonic flows were studied with the aid of two optical laser methods which do not affect the flow characteristics. The laser-Doppler anemometer (LDA) makes use of the frequency shift of laser light which is scattered on submicroscopic particles in the flowing medium. The crossed-beam method is based on the computational evaluation of data concerning the directional changes of two laser beams which intersect in the flow. The directional changes are produced by the fluctuations of the density gradient. A random statistical sampling method was developed in connection with the employment of the LDA.
Author

N77-27349*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SURFACE HEAT FLUX DETERMINATION: AN ANALYTICAL AND EXPERIMENTAL STUDY USING A SINGLE EMBEDDED THERMOCOUPLE

S. D. Williams and Donald M. Curry (Lockheed Electronics Co., Inc., Houston, Tex.) [1977] 39 p refs

(NASA-TM-58204) Avail: NTIS HC A03/MF A01 CSCL 20M

A numerical method by which data from a single embedded thermocouple can be used to predict the transient thermal environment for both high- and low-conductivity materials is described. The results of an investigation performed to verify the method clearly demonstrate that accurate, transient, surface heating conditions can be obtained from a thermocouple 1.016 centimeters from the heating surface in a low-conductivity material. Space shuttle orbiter thermal protection system materials having temperature- and pressure-dependent properties, and typical orbiter entry heating conditions were used to verify the accuracy of the analytical procedure. Analytically generated, as well as experimental, data were used to compare predicted and measured surface temperatures. Author

N77-27350*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A GENERALIZED ORTHOGONAL COORDINATE SYSTEM FOR DESCRIBING FAMILIES OF AXISYMMETRIC AND TWO-DIMENSIONAL BODIES

Peter A. Gnoffo Washington Jun. 1977 61 p refs

(NASA-TM-X-3468; L-11175) Avail: NTIS HC A04/MF A01 CSCL 20D

A generalized curvilinear orthogonal coordinate system is presented which can be used for approximating various axisymmetric and two-dimensional body shapes of interest to aerodynamicists. Such body shapes include spheres, ellipses, spherically capped cones, flat-faced cylinders with rounded corners, circular disks, and planetary probe vehicles. A set of transformation equations is also developed whereby a uniform velocity field approaching a body at any angle of attack can be resolved in the transformed coordinate system. The Navier-Stokes equations are written in terms of a generalized orthogonal coordinate system to show the resultant complexity of the governing equations. Author

N77-27351# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

A SPECTROSCOPIC INVESTIGATION OF COMBUSTION-DRIVEN IMPLOSIONS

Randy A. Roig May 1977 32 p refs Sponsored in part by Natl. Res. Council of Can.

(Grant AF-AFOSR-3303-77)

(UTIAS-214; CN-ISSN-0082-5255) Avail: NTIS HC A03/MF A01

Time and spatially-resolved spectroscopic studies were made of imploding shock waves in a 20-cm diameter hemispherical chamber filled with 2H2 + O2 mixtures at high initial pressures (7-56 atm). Changes in the initiation system (an exploding wire) have improved the precision of the focus and the reproducibility of the implosion pulse. By using the black body character of the plasma radiation above 3,000 A, the temperature structure of the implosion was determined both temporally and spatially as a function of initial filling pressure. It was found that peak temperatures (4500-5100 K), averaged over a rectangular area 3 mm x 9 mm centered near the origin, increased monotonically as a function of filling pressure, while implosion pulse durations (8.5-4.0 microns) underwent a monotonic decrease. Author

N77-27352*# California State Univ., Long Beach.

CALCULATION OF LAMINAR AND TURBULENT BOUNDARY LAYERS FOR TWO-DIMENSIONAL TIME-DEPENDENT FLOWS Final Report

Tuncer Cebeci Washington NASA Jun. 1977 36 p refs

(Contract NAS1-13656)

(NASA-CR-2820) Avail: NTIS HC A03/MF A01 CSCL 20D

A general method for computing laminar and turbulent boundary layers for two-dimensional time-dependent flows is presented. The method uses an eddy-viscosity formulation to model the Reynolds shear-stress term and a very efficient numerical method to solve the governing equations. The model was applied to steady two-dimensional and three-dimensional flows and was shown to give good results. A discussion of the numerical method and the results obtained by the present method for both laminar and turbulent flows are discussed. Based on these results, the method is efficient and suitable for solving time-dependent laminar and turbulent boundary layers. Author

N77-27353# Sandia Labs., Albuquerque, N. Mex. Heat Transfer and Fluid Mechanics Div.

STEADY THERMAL CONVECTION FROM A CONCENTRATED SOURCE IN A POROUS MEDIUM

Charles E. Hickox and Herman A. Watts Nov. 1976 30 p refs

(Contract E(29-1)-789)

(SAND-76-0562) Avail: NTIS HC A03/MF A01

Numerical and approximate analytical solutions are presented for the steady thermal convection in a porous medium resulting from a point source located on the lower boundary of a semi-infinite region. The approximate analytical solution is found to be adequate for Rayleigh numbers greater than 100. Below this value, it is necessary to use numerical techniques to obtain accurate representations of the temperature and flow fields. The results are useful for the preliminary analysis of heat transfer and fluid flow effects due to the implantation of encapsulated nuclear waste material in the seabed. ERA

N77-27354# Los Alamos Scientific Lab., N. Mex.

LINEAR ITERATIVE TECHNIQUE FOR SOLUTION OF NONLINEAR THERMAL NETWORK PROBLEMS

C. M. Seabourn Nov. 1976 43 p refs

(Contract W-7405-eng-36)

(LA-6382) Avail: NTIS HC A03/MF A01

A method for rapid and accurate solution of linear and/or nonlinear thermal network problems is described. It is a matrix iterative process that converges for nodal temperatures and variations of thermal conductivity with temperature. The method is computer oriented and can be changed easily for design studies. ERA

N77-27355# Argonne National Lab., Ill. Components Technology Div.

INTRUSION OF FLUID INTO THE INFLOW BRANCH OF A 180-DEG-APPROACH MIXING TEE

Walter Debler (Michigan Univ., Ann Arbor) Sep. 1976 42 p refs

(Contract W-31-109-eng-38)

(ANL-CT-76-47) Avail: NTIS HC A03/MF A01

Two mathematical models were developed to estimate the extent of density-driven intrusion of a warmer fast flowing fluid into a cooler fluid's inlet conduit in a 180 deg approach mixing tee. One is an inviscid model which incorporates two additional simplifying assumptions to give an initial estimate of the significance of the temperature difference and fluid velocity. This estimate is an initial step in an iterative procedure for a numerical solution scheme. The second method is a perturbation solution for a low Reynolds number flow. The matching of the solution in two regimes will require the numerical solution of equations to determine the associated coefficients. Once this is done streamline patterns can be drawn for a variety of Froude, Reynolds, and Prandtl numbers. ERA

N77-27356# Sandia Labs., Albuquerque, N. Mex.

MASS TRANSPORT IN DEAD-END TUBES WITH SELECTIVELY PERMEATING WALLS

D. R. Chenoweth Oct. 1976 190 p refs

(Contract E(29-1)-789)

(SAND-76-8246) Avail: NTIS HC A09/MF A01

The transport of gaseous species in dead-end tubes having selectively permeating walls was investigated. The limits of validity for the modeling assumptions used are established and are given in terms of a series of inequalities involving the key parameters. Analytical results are generated via exact limiting solutions as well as numerical integration of the governing equations for both positive and negative global velocity cases. Tube materials having specie separation ratios varying from unity to very large or very small values are included. The effective separation ratio for a tube may be either greater or less than that for the tube material in slab form. The possibility of using secondary control species

to favorably alter the flow characteristics of primary species is demonstrated. Data is given which verifies the large effects which the presence of a low permeating specie in the tube bore can have on the flow of another specie which readily permeates the tube walls. ERA

N77-27357# Dartmouth Coll., Hanover, N.H.
SEPARATED FLOW MODEL OF TWO-PHASE FLOW Interim Report
Graham B. Wallis, Horst J. Richter, and Jing T. Kuo Dec. 1976 142 p refs Sponsored by Elec. Power Res. Inst.
(EPRI-NP-275) Avail: NTIS HC A07/MF A01

The separated flow model of two-phase flow is discussed. The general framework of equations and the need for evaluating the usefulness of this formulation when it is applied to relatively simple flow regimes is included. The applications chosen for testing the theory are: flashing, including critical flow, and flow of bubbles, suspended in water, through nozzles. The first topic is being studied using published data; several forms of the interaction terms are being investigated. The second topic is being studied by gathering data on bubble trajectories and comparing these with predictions. Preliminary results and plans for further experiments are described. ERA

N77-27358# Hanford Engineering Development Lab., Richland, Wash.
WATER AND GAS RELEASE FROM HEATED CONCRETE
J. D. McCormack and A. K. Postma 1976 31 p refs Presented at NRC Safety Technol. Meeting on Inherent Retention, Washington, D. C., 21 Sep. 1976
(Contract E(45-1)-2170)
(HEDL-SA-1117; Conf-760941-1) Avail: NTIS HC A03/MF A01

A methematical model for predicting water and gas release from heated concrete is described. The heating conditions of interest are those associated with postulated accidents in LMFBR plants. The scope of the program includes development of a mechanistic model of moisture and gas transport in heated concrete, experimental measurements on concrete to provide needed transport coefficients, and overall substantiation of the model. Work completed to date indicates that the dominant mechanism for water and gas transport in heated concrete is a pressure-driven flow of fluid through concrete pores. Water may exist as vapor, as liquid, and as a sorbed phase. All three forms, and interchange between the three forms, must be recognized in a satisfactory model. Finite difference equations were written for a model in which water moves between concrete nodes as a result of pressure and concentration gradients. ERA

N77-27359# PFR Engineering Systems, Inc., Marina Del Rey, Calif.
HEAT TRANSFER AND PRESSURE DROP CHARACTERISTICS OF DRY TOWER EXTENDED SURFACES. PART 2: DATA ANALYSIS AND CORRELATION
15 Jun. 1976 69 p refs Prepared for Battelle Memorial Inst., Richland, Wash.
(Contract E(45-1)-1830)
(BNWL-PFR-7-102) Avail: NTIS HC A04/MF A01

A summary is presented of studies of the heat transfer and pressure drop characteristics of extended surfaces. The summary is based on data that were compiled and analyzed with the objectives of determining the effects of geometrical configurations of an extended surface tube bank on its heat transfer and pressure drop characteristics. A generalized correlation of heat transfer and friction losses was developed on the basis of this analysis. These correlations can be used to predict the performance of an extended surface tube bank of specified geometry and flow conditions. ERA

N77-27360# Naval Intelligence Support Center, Washington, D. C.
THEORY OF TURBULENT VISCOSITY IN WAVE MOTION
S. A. Kitaygorodskiy 1 Feb. 1977 9 p refs Transl. into ENGLISH from Izv. an SSSR, Ser. Geofiz. (USSR), no. 5, 1959 p 773-777
(AD-A036891; NISC-Trans-3902) Avail: NTIS HC A02/MF A01 CSCL 08/3

At the initial stage of development of wind waves in the sea, the energy dissipation is determined by the molecular viscosity. This report discusses various theoretical models of turbulence in wave motion and compares them with existing indirect and empirical data. GRA

N77-27361# Purdue Univ., Lafayette, Ind.
TRANSONIC FLOW PROBLEMS IN TURBOMACHINERY
T. C. Adamson, Jr., ed. and M. F. Platzer, ed (Naval Postgraduate School) Feb. 1977 665 p refs Conf. Proc. of a Workshop, Monterey, Calif., 11-12 Feb. 1976 Sponsored in part by AFOSR Prepared by Michigan Univ., Ann Arbor
(Contract N00014-75-C-1143; Proj. SQUID; NR Proj. 098-038)
(AD-A037060; SQUID-MICH-16-PU) Avail: NTIS HC A99/MF A01 CSCL 13/7

This report contains the proceedings of the Workshop on Transonic Flow Problems in Turbomachinery held on February 11-12, 1976 at the Naval Postgraduate School, Monterey, California. This workshop was co-sponsored by Project SQUID, Naval Air Systems Command and the Air Force Office of Scientific Research. The workshop participants included representatives from universities, industry, government and abroad.
Author (GRA)

N77-27362# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
STRAIGHT DUCT SUPERSONIC DIFFUSER FLOW IN A LUDWIEG TUBE WITH UPSTREAM DIAPHRAGM Interim Report
Nesim Abuaf Dec. 1976 56 p
(Contract F44620-73-C-0032)
(AD-A037674; Scientific-6; AFOSR-77-0201TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

The starting process of supersonic flow in a nozzle followed by constant area, straight duct diffusers were studied in a Ludwieg tube equipped with an up stream diaphragm. The time required to establish steady flow from rest at the exit of the supersonic nozzle was determined from shadowgraph pictures of the flow field and from static pressure measurements. The initial pressure ratios across the diaphragm to start the supersonic flow at the nozzle exit, are also reported. They are compared with the minimum pressure ratio required to sustain the flow at the nozzle exit during the first flow cycle Ludwig tube operation. GRA

N77-27363# Aerospace Corp., El Segundo, Calif.
ON THE SPECTRA OF THE ORR-SOMMERFELD EQUATION Final Report
John W. Murdock (University Coll., London) and Keith Stewartson (University Coll., London) 31 Jan. 1977 31 p refs
(Contract F04701-76-C-0077)
(AD-A038020; TR-0077(2550-15)-3) Avail: NTIS HC A03/MF A01 CSCL 20/4

It is shown that the continuous spectra of both the temporal and spatial eigenvalues of the Orr-Sommerfeld equation for a Blasius flow can be reinterpreted as discrete spectra of the heat conduction and diffraction types. Most of the general properties of the discrete spectrum of the Orr-Sommerfeld equation discovered by Mack can be understood on the basis of a simple model equation. Author (GRA)

N77-27364# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
MEASUREMENTS OF MOLECULAR STRETCHING IN IRROTATIONAL FLOW BY LIGHT SCATTERING M.S. Thesis
Gary Lee Dennison Nov. 1976 75 p refs
(AD-A039061) Avail: NTIS HC A04/MF A01 CSCL 20/4

Extreme stretching of polymer molecules has been postulated as the basic drag-reducing mechanism in turbulent flows of dilute polymer solutions. The stretching is predicted to occur in significant portions of the turbulent flow where the strain rate field is sufficiently rotation-free and above the threshold for the particular polymer additive. To provide support for these predictions, the explicit purpose of this investigation was to determine experimentally the streamwise extensions of poly (ethylene oxide) molecules in such an isolated strain rate field. GRA

N77-27365# Kinergetics, Inc., Tarzana, Calif.
[HEAT EXCHANGER FABRICATION BY BONDING WIRE SCREENS INTO LOW CONDUCTIVITY] Final Report
M. O. Bennett and R. C. Lins Apr. 1976 40 p refs
(Contract DAAK02-73-C-0323)
(AD-A033632; CP-2028F) Avail: NTIS HC A03/MF A01 CSCL 13/1

The objective was to demonstrate the feasibility of manufacturing compact heat exchangers by bonding wire screens into low conductivity (i.e. plastic) material and to use the manufacturing techniques to manufacture a set of compact, high-performance, cryogenic heat exchangers suitable for integration into a Claude cycle refrigeration system. GRA

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N77-27366* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
OPTO-MECHANICAL SUBSYSTEM WITH TEMPERATURE COMPENSATION THROUGH ISOTHEMAL DESIGN Patent
Francis E. Goodwin, inventor (to NASA) (Hughes Aircraft Co., Los Angeles) Issued 14 Jun. 1977 8 p Filed 28 Apr. 1976 Supersedes N76-23625 (14 - 14, p 1808) Sponsored by NASA
(NASA-Case-GSC-12059-1; US-Patent-4,030,047; US-Patent-Appl-SN-680957; US-Patent-Class-331-94.5D; US-Patent-Class-331-94.5T; US-Patent-Class-350-253) Avail: US Patent Office CSCL 14B

An opto-mechanical subsystem for supporting a laser structure which minimizes changes in the alignment of the laser optics in response to temperature variations is described. Both optical and mechanical structural components of the system are formed of the same material, preferably beryllium, which is selected for high mechanical strength and good thermal conducting qualities. All mechanical and optical components are mounted and assembled to provide thorough thermal coupling throughout the subsystem to prevent the development of temperature gradients. Official Gazette of the U.S. Patent Office

N77-27367* National Aeronautics and Space Administration. Pasadena Office, Calif.
PENETROMETER Patent
Isak Kloc, inventor (to NASA) (JPL) Issued 30 Nov. 1971 5 p Filed 19 Jan. 1970 Sponsored by NASA
(NASA-Case-NPO-11103-1; US-Patent-3,623,359; US-Patent-Appl-SN-3654; US-Patent-Class-73-84) Avail: US Patent Office CSCL 14B

A penetrometer was developed for use in empirically determining the load-bearing characteristics of a surface inclined with respect to a horizontal plane. The device is characterized by a penetrometer mount rotatably supporting a vertically driven probe. The probe is supported for simultaneous displacement in both vertical and lateral directions. The extent of resulting lateral displacement imposed on the probe, as vertical displacement operatively is imparted thereto, can be detected and measured for purposes of accurately indicating the true load-bearing characteristics of the surface, regardless of its angle of inclination. Official Gazette of the U.S. Patent Office

N77-27368* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PLATINUM RESISTANCE THERMOMETER CIRCUIT Patent
Louis W. McFadin, inventor (to NASA) Issued 19 Oct. 1971 3 p Filed 16 Mar. 1970
(NASA-Case-MSC-12327-1; US-Patent-3,613,454; US-Patent-Appl-SN-19572; US-Patent-Class-73-362AR) Avail: US Patent Office CSCL 14B

A platinum wire resistor is exposed to a temperature to be measured. The voltage drop across the resistor is input to a differential amplifier. The platinum resistor is connected to ground through a sensing resistor. Variations in voltage across the sensing resistor drive the differential amplifier to maintain a constant current through the resistance thermometer and the sensing resistor. A second differential amplifier connected across the resistive thermometer forms an output signal which is related to the temperature of the sensor and, hence, proportional to the measured temperature.
Official Gazette of the U.S. Patent Office

N77-27369*# EG and G Washington Analytical Services Center, Inc., Rockville, Md. Wolf Research and Development Group.
ALTIMETER ERROR SOURCES AT THE 10-cm PERFORMANCE LEVEL
C. F. Martin Apr. 1977 70 p refs
(Contract NAS6-2639)
(NASA-CR-141420) Avail: NTIS HC A04/MF A01 CSCL 01D

Error sources affecting the calibration and operational use of a 10 cm altimeter are examined to determine the magnitudes of current errors and the investigations necessary to reduce them to acceptable bounds. Errors considered include those affecting operational data pre-processing, and those affecting altitude bias determination, with error budgets developed for both. The most significant error sources affecting pre-processing are bias calibration, propagation corrections for the ionosphere, and measurement noise. No ionospheric models are currently validated at the required 10-25% accuracy level. The optimum smoothing to reduce the effects of measurement noise is investigated and found to be on the order of one second, based on the TASC model of geoid undulations. The 10 cm calibrations are found to be feasible only through the use of altimeter passes that are very high elevation for a tracking station which tracks very close to the time of altimeter track, such as a high elevation pass across the island of Bermuda. By far the largest error source, based on the current state-of-the-art, is the location of the island tracking station relative to mean sea level in the surrounding ocean areas. Author

N77-27370*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A LOW COST, PORTABLE INSTRUMENT FOR MEASURING EMITTANCE
G. McDonald Jun. 1977 11 p refs Presented at the 10th Ann. Meeting of the Intern. Solar Energy Soc., Orlando, Fla., 6-10 Jun. 1977
(NASA-TM-73697) Avail: NTIS HC A02/MF A01 CSCL 14B

A low cost, portable instrument was developed with which emittance can be measured by comparison to a standard. A reflector collects infrared radiation from a heated sample onto a low mass, black detector and the temperature rise of the black detector is measured with a thermocouple and meter. Graphical examples are presented for determination of emittance from measurements made on a sample at any known temperature.
Author

N77-27371# Wyoming Univ., Laramie.
RAPID, LOW-COST, IMAGE ANALYSIS THROUGH VIDEO PROCESSING
Richard A. Levinson, Ronald W. Marrs, and Deborah G. Grantham 1 Sep. 1976 66 p refs
(Contract E(05-1)-1648)
(GJBX-37(76)) Avail: NTIS HC A04/MF A01

The functions, components, and operation of a video system performing image analysis is described. Video capabilities include: color separation, color addition/subtraction, contrast stretch, dark level adjustment, density analysis, edge enhancement, scale matching, image mixing (addition and subtraction), image ratioing, and construction of false color composite images. Rapid input of non-digital image data, instantaneous processing and display, relatively low initial cost, and low operating cost gives the video system a competitive advantage over digital equipment. Complex preprocessing, pattern recognition, and statistical analyses must still be handled through digital computer systems. Potential applications are discussed including uranium exploration, petrole-

um exploration, tectonic studies, geologic mapping, hydrology sedimentology and petrography, anthropology, and studies on vegetation and wild-life habitat. ERA

N77-27372# Sandia Labs., Albuquerque, N. Mex. Transducer Evaluation and Calibration Div.

THE 1 g, LOW FREQUENCY ACCELEROMETER CALIBRATOR

Pat L. Walter Nov. 1976 17 p
(Contract E(29-1)-789)
(SAND-76-0333) Avail: NTIS HC A02/MF A01

A low g, low frequency harmonic motion device was developed to evaluate and accurately calibrate servo (force balance) accelerometers. This device generates a 1 g peak, sinusoidally varying acceleration over a frequency range from zero to 50 Hz. This is accomplished by mounting an accelerometer with its sensitive axis normal to a shaft rotating at any selected rpm from 3 to 3,000 within the earth's gravitation field. Conventional rectilinear vibration exciters require extreme displacement amplitudes to achieve the same results at low frequencies; for example: 20mm P-P at 5 Hz or 500mm P-P at 1 Hz. In addition, this calibrator permits correlation of dynamic response with a static response observed on a conventional 1 g tilt table. ERA

N77-27373# California Univ., Livermore. Lawrence Livermore Lab.

MEASUREMENT OF RADIATION INDUCED TRANSIENTS IN HYBRID MICROCIRCUITS BY MAGNETIC THIN FILM SENSOR/RECORDERS

E. J. Hsieh, K. E. Vindelov, T. G. Brown, and D. E. Miller 21 Sep. 1976 21 p refs
(Contract W-7405-eng-48)
(UCID-17269) Avail: NTIS HC A02/MF A01

Magnetic thin film transient current sensor/recorders were modified to make two types of nuclear test measurements, transient currents in hybrid microcircuits, and internal electromagnetic pulse (IEMP) fields. The measurements were made possible by the invention of split-domain sensor/recorders which can measure bilateral currents and can be reset and readout on location. The sensor/recorders were used in two underground nuclear tests and numerous calibration tests in radiation-simulation machines. The data showed that the nuclear environment had negligible effect on the sensor/recorder's operation and the recorded informations on the sensory recorders were the signals intended to be monitored. Also, the experimental data agreed with the theoretical analysis in controlled experiments. The data were examined first by on location readout with a magnetic tape viewer and later by Kerr magneto-optic readout in the laboratory. ERA

N77-27374# Cornell Univ., Ithaca, N.Y.

COMPUTER-CONTROLLED TIME-OF-FLIGHT ATOM-PROBE FIELD-ION MICROSCOPE FOR THE STUDY OF DEFECTS IN METALS

T. M. Hall, A. Wagner, and D. N. Seidman Aug. 1976 36 p refs
(Contract EY-76-S-02-3158)
(COO-3158-50) Avail: NTIS HC A03/MF A01

A time-of-flight (TOF) atom-probe field-ion microscope (FIM) specifically designed for the study of defects in metals is described. The entire process of applying the evaporation pulse to the specimen, measuring the dc and pulse voltages, and analyzing the TOF data is controlled by a Nova 1220 computer. Data in the form of a histogram of the number of events versus the mass-to-charge ratio is displayed on a Tektronix graphics terminal. The instrument can clearly resolve the seven isotopes of molybdenum and the five isotopes of tungsten. Investigations of alloys show that the concentration of rhenium in a W-25 at. percent Re alloy; and the concentrations of titanium and zirconium in a Mo-1.0 at. percent Ti alloy and a Mo-1.0 at. percent Ti0.08 at. percent Zr alloy can be easily measured. Investigations of a low swelling stainless steel alloy (LSIA) and a metallic glass alloy (Metglas 2826) show that all constituents present at a level of 0.05 at. percent or higher can be readily determined. ERA

N77-27375# Argonne National Lab., Ill.

EXTRINSIC FACTORS AFFECTING ACCURACY OF ULTRASONIC FLOWMETERS FOR LMFBR'S

W. W. Managan Aug. 1976 103 p refs
(Contract W-31-109-eng-38)
(ANL-CT-76-40) Avail: NTIS HC A06/MF A01

Assuming that ultrasonic flowmeters of suitable intrinsic accuracy are feasible, factors extrinsic to the flowmeter which affect the accuracy such as asymmetric flow profile, regions of high turbulence, and thermal stratification were explored. By integrating isovelocity flow profile maps, the predicted performance of various flowmeter configurations may be compared to experimental data. For the two pipe arrangements the single diametral path flowmeter results were within 5 percent of true flow rate. Theoretical correction factors could reduce the error for the straight pipe but increased the error for asymmetrical flow. On the same pipe arrangements a four path ultrasonic flowmeter spaced for Gaussain integration gave less than 1 percent error. ERA

N77-27376# Atomics International, Canoga Park, Calif.

DETECTION OF LIQUID METAL TO GAS LEAKS IN LMFBR'S

J. A. Morejon 1976 10 p Presented at Conf. on Productivity through Instr. and Control, Houston, Tex., 10 Oct. 1976
(Contract E(04-3)-0824)
(CONF-761007-5) Avail: NTIS HC A02/MF A01

Instruments were developed and tested to evaluate response time and sensitivity to liquid metal leaks in simulated LMFBR environments. The instruments tested include: (1) aerosol-type detectors; (2) conductivity-type detectors; (3) gas chromatograph, and (4) smoke detectors. The results from these tests indicate that the aerosol-type detectors were the most sensitive in both air and inerted environments for detection of small liquid metal leaks in the temperature range of 600 F to 1000 F. Conductivity-type detectors can be utilized for detection of larger leaks (on the order of kg/min); however, their performance for small leaks (gm/hr) is not too effective. The gas chromatograph monitored the level of H2 gas in the test cell which was produced from the liquid metal/water reaction. It is concluded that an effective system for detection of liquid metal-to-gas leaks in LMFBR's can be designed utilizing instruments and techniques readily available at this time. ERA

N77-27377# Energy Research and Development Administration, Bartlesville, Okla.

EVALUATION OF GAS-MONITORING DEVICES

R. M. Ray and F. E. Armstrong Dec. 1976 28 p refs
(BERC/IC-76/5) Avail: NTIS HC A03/MF A01

The philosophy of testing and discussion of specific equipment utilized for performance evaluations at the Bartlesville Energy Research Center of the Energy Research and Development Administration are described in detail. Sample equations for statistical analysis of data collected and for calculation of gas concentrations in static and dynamic blending systems are given, but no rigorous treatment of the data or equations is offered. Most testing procedures are discussed in general terms, but some specific procedures are discussed in detail. ERA

36 LASERS AND MASERS

Includes parametric amplifiers.

N77-27378 Ohio State Univ., Columbus.

THE EFFECT OF TURBULENCE ON LASER BEAM QUALITY Ph.D. Thesis

Richard Byram Rivir 1976 224 p
Avail: Univ. Microfilms Order No. 77-2485

The ranges of parameters which were investigated are: (1) mean fluid velocity: from zero to 20 meters per second, (2) turbulence Reynolds numbers: to 16,000 (3) velocity turbulence intensities: to 40%, (4) temperature turbulence intensities: to .6%, (5) index of refraction fluctuations: to 3.7 x 10 to the minus sixth power, (6) propagation path length: 23 cm, (7) nominal laser beam diameters: 50mm, 30mm, 14mm and 1.5mm, (8) wave lengths of the laser beams: 632.8nm and 441.6nm, (9) beam diameter integral temperature turbulence scale: D/lambda << 1 to D/lambda about 1; and (10)

attenuation coefficient: alpha L sub o << 1, aL sub o about 1, aL sub o 1. Dissert. Abst.

N77-27379*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SHOCK ISOLATOR FOR DIODE LASER OPERATION ON A CLOSED-CYCLE REFRIGERATOR
D. F. Jennings and J. J. Hillman Jun. 1977 10 p refs Submitted for publication
(NASA-TM-X-71354; X-693-77-143) Avail: NTIS HC A02/MF A01 CSCL 20E

A device developed to isolate the diode laser from impact shocks delivered during the expansion phase of the Solvay cycle of a helium refrigerator is briefly described. The device uses intermediate cold sta..ons in the stand-off, which permit the stand-off to be short and rigid while minimizing the thermal load at the diode mount. J.M.S.

N77-27380*# Becker (Carl H.), Cupertino, Calif.
STUDY REPORT ON LASER STORAGE AND RETRIEVAL OF IMAGE DATA
Carl H. Becker 7 Jun. 1976 228 p refs
(Contract NAS5-22977)
(NASA-CR-152551) Avail: NTIS HC A11/MF A01 CSCL 20E

The theoretical foundation is presented for a system of real-time nonphotographic and nonmagnetic digital laser storage and retrieval of image data. The system utilizes diffraction-limited laser focusing upon thin metal films, melting elementary holes in the metal films in laser focus. The metal films are encapsulated in rotating flexible mylar discs which act as the permanent storage carries. Equal sized holes encompass two dimensional digital ensembles of information bits which are time-sequentially (bit by bit) stored and retrieved. The bits possess the smallest possible size, defined by the Rayleigh criterion of coherent physical optics. Space and time invariant reflective read-out of laser discs with a small laser, provides access to the stored digital information. By eliminating photographic and magnetic data processing, which characterize the previous state of the art, photographic grain, diffusion, and gamma-distortion do not exist. Similarly, magnetic domain structures, magnetic gaps, and magnetic read-out are absent with a digital laser disc system. Author

N77-27381# California Univ., Livermore. Lawrence Livermore Lab.
SYMMETRY AND ILLUMINATION UNIFORMITY REQUIREMENTS FOR HIGH DENSITY LASER-DRIVEN IMPLOSIONS
W. C. Mead and J. D. Lindl 22 Oct. 1976 34 p refs Presented at 18th Ann. Meeting of the Am. Phys. Soc., Div. of Plasma Phys., San Francisco, 15-19 Nov. 1976
(Contract W-7405-eng-48)
(UCRL-78459; Conf-761108-21) Avail: NTIS HC A03/MF A01

Criteria are discussed for formation of a low density corona, preheated supersonically, which increases the tolerance of high convergence implosions to non-uniform illumination by utilizing thermal smoothing. Double shell target designs are compared without and with atmosphere production. Two significant penalties are incurred with atmosphere production using 1 mu m laser light. First, a large initial shock at the ablation surface limits the pulse shaping flexibility, and degrades implosion performance. Second, the mass and heat capacity of the atmosphere reduce the energy delivered to the ablation surface and the driving pressures obtained for a given input energy. Improvement is possible using 2 mu m light for the initial phase of the implosion. ERA

N77-27382# California Univ., Livermore. Lawrence Livermore Lab.
ARGUS LASER FUSION FACILITY
D. R. Speck and W. W. Simmons 28 Oct. 1976 26 p refs Presented at the Plasma Phys. Meeting of the Am. Phys. Soc., San Francisco, 15-19 Nov. 1976
(Contract W-7405-eng-48)
(UCRL-78438; Conf-761108-11) Avail: NTIS HC A03/MF A01

Beam diagnostics which characterize each shot include the time-integrated spatial profile and the time resolved intensity/power at the target. Demonstrated performance to date includes (1) peak power in excess of 2 thousand watts at the target is achieved with regularity, (2) maximum system brightness in excess of 10 to the seventeenth power watts/square cm ster; (3) shot-to-shot pointing stability within 50 mu radians is achieved over periods of days; and (4) successful target experiments have been performed with pulses of from 30 to 500 ps duration.ERA

N77-27383# Sandia Corp., Livermore, Calif.
DEVELOPMENT OF GLASSES FOR APPLICATION AS LASER FUSION TARGETS
J. E. Shelby Jan. 1977 24 p refs
(Contract EY-76-C-04-0789)
(SAND-76-8235) Avail: NTIS HC A02/MF A01

Improved materials for the production of these glass microspheres were developed. Results indicate that lithium aluminoborate, aluminosilicate, and borosilicate glasses (in that order of preference) may be used for such applications. ERA

N77-27384# Illinois Univ., Urbana.
RECENT NUCLEAR PUMPED LASER RESULTS
G. H. Miley, W. E. Wells, M. A. Akerman, and J. H. Anderson 1976 7 p refs Presented at the Princeton Univ. Conf. on Partially Ionized Plasmas, Princeton, N. J., Jun. 1976
(Contract E(11-1)-2007)
(COO-2007-80; Conf-760683-1) Avail: NTIS HC A02/MF A01

Recent direct nuclear pumped laser research at the University of Illinois was concentrated on experiments with three gas mixtures (Ne-N2, He-NeO2, and He-Hg). One mixture was made to lase, and gain was achieved with the other two. All three of these mixtures are discussed with particular attention paid to He-Hg(+). Of interest for DNP work is the 6150-A ion transition in Hg. The upper state of this transition is formed directly by charge transfer and by Penning ionization. ERA

N77-27385# Illinois Univ., Urbana.
DEMONSTRATION OF THE FIRST VISIBLE WAVELENGTH DIRECT NUCLEAR PUMPED LASER Ph.D. Thesis
Marvin Alfred Akerman 1976 83 p refs
(Contract EY-76-S-02-2007)
(COO-2007-78) Avail: NTIS HC A05/MF A01

The first direct nuclear pumped laser to operate on a visible wavelength is described, whereas previous nuclear lasers have operated in the infrared. The Sandia Pulsed Reactor II was used as a high flux source of neutrons that pumped a helium-mercury gas laser via the high energy products of the B-10(n,alpha)Li-7 nuclear reaction. No other source of energy was utilized. Lasing was observed at 6,150 A. The thermal neutron flux threshold for lasing was approximately 1 x 10 to the 16th power n/sq cm/sec, and the laser output was continuous over the 400 micro sec operating time of the nuclear reactor. The laser signal appeared to increase linearly with thermal neutron flux. ERA

N77-27386# California Univ., Livermore. Lawrence Livermore Lab.
STATUS OF NAVY DIRTY AIR BREAKDOWN RESEARCH
A. Edwards and J. A. Fleck, Jr. Dec. 1976 14 p ref
(Contract W-7405-ENG-48)
(UCID-17350) Avail: NTIS HC A02/MF A01

The LASNEX code has been upgraded to include optical ray tracing of laser light through the dynamically changing Lagrangian hydrodynamic mesh. Calculations have been carried out to simulate the absorption of laser light by a two-dimensional breakdown plasma initiated by a vaporizing dust particle. ERA

N77-27387# Los Alamos Scientific Lab., N. Mex.
LASER FUSION PROGRAM Progress Report, 1 Jan. - 30 Jun. 1976
Eugene Stark Nov. 1976 135 p refs
(Contract W-7405-eng-36)
(LA-6510-PR) Avail: NTIS HC A07/MF A01

New types of lasers must be developed to provide the desired energy per pulse, pulse length, pulse shape, wavelength, and efficiency for laser fusion applications. This advanced laser research has focused on rare gas oxides and on Hg2 excimers. ERA

N77-27388# California Univ., Livermore. Lawrence Livermore Lab.

DATA ACQUISITION SYSTEM FOR FUSION DIAGNOSTICS ON THE ARGUS LASER

J. R. Greenwood, D. E. Campbell, and C. E. Frerking Sep. 1976 15 p refs Presented at Plasma Phys. meeting of the Amer. Phys. Soc., San Fransico, Calif., 15 Nov. 1976

(Contract W-7405-eng-48)

(UCRL-78435; Conf-761108-6) Avail: NTIS HC A02/MF A01

The system is based upon a PDP-11/40 minicomputer and CAMAC interfaces. Highspeed transient digitizers, calorimeter digitizing modules and time integrated data are interfaced through CAMAC over a fiber optic serial highway. The system allows for dynamic definition of the experimental environment by an operator, automatic data acquisition during a shot. Two interactive graphics terminals allow experimenters real-time access to target shot data. ERA

N77-27389# California Univ., Livermore. Lawrence Livermore Lab.

CALCULATION OF THE SMALL SCALE SELF-FOCUSING RIPPLE GAIN SPECTRUM FOR THE CYCLOPS LASER SYSTEM: A STATUS REPORT

J. A. Fleck, Jr., J. R. Morris, and P. F. Thompson Oct. 1976 15 p refs

(Contract W-7405-eng-48)

(UCID-17356) Avail: NTIS HC A02/MF A01

The FLAC code (Fourier Laser Amplifier Code) was used to simulate the CYCLOPS laser system up to the third B module and to calculate the maximum ripple gain spectrum. The model of this portion of CYCLOPS consists of 33 segments that correspond to 20 optical elements (simulation of the cell requires 2 segments and 12 external air spaces). Author (ERA)

N77-27390# Technische Universitaet, Munich (West Germany). Lab. fuer Reaktorregelung und Anlagensicherung.

REACTOR SAFETY SYSTEMS

P. Kafka 1975 18 p refs Presented at the meeting on Nuclear Power Project Planning and Implementation, Karlsruhe, 17 Sep. 1975

(AED-Conf-75-769-057; Conf-7509129-4) Avail: NTIS (US sales only) HC A02/MF A01; ERDA Depository Libraries

The spectrum of possible accidents may become characterized by the 'maximum credible accident', which will/will not happen. Similarly, the performance of safety systems in a multitude of situations is sometimes simplified to 'the emergency system will/will not work' or even 'reactors are/are not safe'. Any system can be made safer and there is usually some additional cost. The balance of increased safety against the increased costs is analyzed. ERA

N77-27391# California Univ., Livermore. Lawrence Livermore Lab.

SOVIET PAPER ON LASER TARGET HEATING, SYMMETRY OF IRRADIATION, AND TWO-DIMENSIONAL EFFECTS ON COMPRESSION

Harry L. Sahlin 13 Dec. 1976 30 p ref Presented at the Ann. Meeting of the Plasma Phys. Div. of the Am. Phys. Soc., San Francisco, 19 Nov. 1976

(Contract W-7405-eng-48)

(UCID-17328) Avail: NTIS HC A03/MF A01

Theoretical problems of laser target irradiation and compression investigated at the laboratory of quantum radiophysics are discussed. Of significant interest was the absorption and reflection of laser radiation in the corona plasma of a laser target. Author (ERA)

N77-27392# Stanford Research Inst., Menlo Park, Calif.

LASER DAMAGE PHENOMENA IN MATERIALS Final Report, 1 Nov. 1972 - 31 Oct. 1976

T. J. Magee, J. Peng, and R. A. Armistead Nov. 1976 119 p refs

(Contract F44620-73-C-0019; AF Proj. 9751)

(AD-A037163; AFOSR-77-0155TR) Avail: NTIS HC A06/MF A01 CSCL 20/5

This report describes progress on a program to characterize laser-induced damage in selected materials and to identify the role of microstructural defects and radiation damage in altering infrared transmission of laser windows and optical coatings. Author (GRA)

N77-27393# Physical Dynamics, Inc., La Jolla, Calif.

X-RAY LASER APPLICATIONS STUDY Semiannual Technical Report, Apr. - Oct. 1976

S. Jorna Nov. 1976 209 p refs

(Contract N00173-76-C-0151; ARPA Order 2694)

(AD-A037461; PD-LJ-76-132) Avail: NTIS HC A10/MF A01 CSCL 20/5

This report is concerned with potential applications of X-ray lasers. The program is supported by ARPA and monitored by NRL. Applications considered in detail are ESCA (Electron Spectroscopy for Chemical Analysis), X-ray holography, production of micro-electronic circuitry by lithography, X-ray microscopy, metallurgical uses, medico-radiology, radiation chemistry, and effect on nuclear decay rates. The relative merits of X-ray lasers over presently available sources such as synchrotrons and laser plasma sources are also being studied under this program. Author (GRA)

N77-27394# Kansas State Univ., Manhattan. Dept. of Chemistry.

MECHANISMS, BRANCHING RATIOS AND RATE CONSTANTS FOR EXCITATION PROCESSES IN RARE GAS SYSTEMS Annual Technical Report, Jan. 1976 - Jan. 1977

D. W. Setser Jan. 1977 36 p refs

(Contract N00014-76-C-0380; ARPA Order 2840)

(AD-A037496) Avail: NTIS HC A03/MF A01 CSCL 20/5

The work done with support from this contract can be divided into three categories: 1. Measurement of total quenching rate constants and branching fractions for krypton halide formation for metastable krypton atoms reacting with halogen containing molecules. 2. Construction of an apparatus which will permit the measurement of the rate constants for electronic excitation of products resulting from charge transfer reactions of He2. 3. Investigation of the applicability of the ionic-covalent curve-crossing mechanism for the formation of Br2, I2 and other excited states of molecular halogens that have been demonstrated to be candidates for UV lasers. GRA

N77-27395# Georgia Inst. of Tech., Atlanta. School of Physics.

BIBLIOGRAPHY ON SOURCES OF INFORMATION ON PHENOMENA OF INTEREST IN GAS LASER RESEARCH AND DEVELOPMENT

Earl W. McDaniel, Harry W. Ellis, Fred L. Eisele, and Michael G. Thackston Oct. 1976 211 p refs Sponsored by USAMRDL

(AD-A037680; RH-77-1) Avail: NTIS HC A10/MF A01 CSCL 20/5

Persons engaged in gas laser research and development need data from many fields - atomic and molecular physics, gas-phase chemistry, optics and electromagnetic theory, quantum electronics, thermodynamics and heat transfer, gas dynamics, plasma physics and electrical discharges, optical properties of solids, surface physics and chemistry, and other branches of science and engineering. These data are required for the mathematical modeling of lasers, for the choice of materials in the construction of lasers, for the interpretation of laser performance, and for the study of the interaction of laser radiation with matter. This bibliography was compiled in an effort to help fill this need, especially in atomic and molecular physics and gas-phase chemistry. The references listed here are divided into four main groups. The first deals with Atomic Collisions. Here we refer principally to two-body and three-body collisions between electrons, atoms and molecules (neutral and ionized), and photons at impact energies sufficiently low that nuclear forces are unimportant. The next main group of references deals with the structure and properties of atoms and molecules (neutral and ionized). The third group of references deals with lasers - the physics underlying their operation, laser theory, and applications of lasers. The remaining references deal with a variety of subjects. GRA

N77-27396# Rochester Univ., N. Y. Dept. of Physics and Astronomy.

THE DEGREE OF COHERENCE OF RADIATING SYSTEMS

AND THE DIRECTIONALITY OF LIGHT BEAMS Final Report, 30 Jun. - 29 Oct. 1976
Emil Wolf Dec. 1976 17 p refs
(Grant DAAG29-76-G-0268)
(AD-A035736; ARO-14513.2-P) Avail: NTIS HC A02/MF A01 CSCL 20/6

The research was concerned with the characterization of optical wavefields generated by highly coherent sources and with the relationship between the specific intensity of radiation and a second-order correlation function of the field. GRA

N77-27397# Physical Sciences, Inc., Woburn, Mass.
THE FLUID MECHANICS OF PULSED LASER PROPULSION Final Report, 1 Mar. - 30 Jun. 1976
A. N. Pirri, G. A. Simons, and P. E. Nebolsine 31 Jul. 1976 111 p refs
(Contract N00014-76-C-0738; ARPA Order 3176)
(AD-A033887; PSI-TR-60) Avail: NTIS HC A06/MF A01 CSCL 20/5

A fluid mechanical model is developed to assess the performance of a rocket that is propelled by the absorption of radiant energy from a remotely stationed, repetitively pulsed laser. The model describes the flow within a conical nozzle that is subjected to point energy depositions at the apex of the cone. A similarity solution is obtained and the specific impulse and energy efficiencies that may be achieved with such a device are determined. Fluid mechanical constraints limit the range of pulse repetition rates that may be utilized. Preliminary design considerations indicate that a specific impulse of 800 seconds or greater may be achieved with both a laboratory and a full scale device. A two pound laboratory rocket can be accelerated at 10 g's with a 15 joule laser pulsed 25,000 times per second. A one ton rocket will require a megajoule laser operating at 350 pulses per second to achieve an equivalent acceleration. A laboratory experiment to test the theoretical model using multiple CO2 TEA lasers is also designed, and a test plan to compare theory with experiment is outlined. Author (GRA)

N77-27398# Radiation Research Associates, Inc., Fort Worth, Tex.
MULTIPLE SCATTERING EFFECTS UPON MEASUREMENTS WITH THE AFGL LSRVMS LIDAR SYSTEM Final Report, 1 Dec. 1975 - 15 Dec. 1976
Wolfram G. M. Blaettner 15 Jan. 1977 87 p refs
(Contract F19628-76-C-0130; AF Proj. 6670)
(AD-A038976; RRA-T7609; AFGL-TR-77-0003) Avail: NTIS HC A05/MF A01 CSCL 17/8

This report describes Monte Carlo calculations that were made to determine the effects of multiple scattering on the meteorological ranges (visibilities) obtained through a single-scattering analysis of the measured time-dependent signals to be obtained from the AFGL LSRVMS lidar system. Multiple scattering was found to affect the accuracy of visibility measurements in both radiation and advection fogs for low visibilities such that the visibility obtained from the experiment is higher than the true visibility. The deviation of the computed visibility from the true visibility was small (1 to 4%) for the radiation fog model at all visibilities studied, but for the advection fog the deviation of the computed visibility from the true visibility varied from 15% to 2% as the true visibility varied from 50 meters to 1000 meters. Author (GRA)

N77-27399# Washington Univ., Seattle. Applied Physics Lab.
STABILIZED LASER GRAVIMETER Final Report, 1 Jun. 1974 - 31 Oct. 1976
Howard C. Merchant and G. Rodney Huggett 1 Nov. 1976 49 p refs
(Contract F19628-75-C-0042)
(AD-A038902; AFGL-TR-76-0275) Avail: NTIS HC A03/MF A01 CSCL 08/5

The development and testing of a stabilized laser gravimeter is discussed. A parametric excitation system that is adaptable to the gravimeter is also described. The design and initial development of the stabilized laser gravimeter system have been previously described in AFCRL-TR-74-0355. In the design a mirror forming one end of a Fabry-Perot optical cavity is mounted on a mechanical suspension system. The suspension consists of a beam, end loaded to obtain the required sensitivity to changes in gravitation. A He-Ne illuminating laser is locked to a fringe of the Fabry-Perot cavity. A He-Ne laser stabilized by locking to a vibration-rotation absorption line of a methane cell is used as a reference. The output of the system is a beat frequency between the two lasers proportional to the gravity change. The proposed parametric excitation system applies a periodic end load in addition to the static load on the beam suspension system. It has been shown theoretically and experimentally that significant, order of magnitude, gains in sensitivity can be realized by parametric excitation. Author (GRA)

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N77-27400* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
CONTROLLED CAGING AND UNCAGING MECHANISM Patent
Robert M. Steudl, inventor (to NASA) Issued 14 Dec. 1971 6 p Filed 28 May 1970 Supersedes N70-12345 (08 - 19, p 3473)
(NASA-Case-GSC-11063-1; US-Patent-3,628,113;
US-Patent-Appl-SN-41431; US-Patent-Class-318-267;
US-Patent-Class-318-468; US-Patent-Class-318-470;
US-Patent-Class-318-675) Avail: US Patent Office CSCL 13I

A positioning mechanism is described. The mechanism is intended for remote locking and releasing of instruments having a geared down motor driving a cam, the direction and duration of motor rotation being controlled by a circular printed circuit mounted for rotation on the cam shaft, the printed circuit cooperating with a plurality of wiper contacts to effect reversal of polarity in the motor to prevent overtravel thereof.
Official Gazette of the U.S. Patent Office

N77-27401 State Univ. of New York, Buffalo.
MECHANICAL SYSTEMS MODEL FOR DYNAMIC SOIL-WHEEL INTERACTION Ph.D. Thesis
Chien-Tzu Wang 1976 246 p
Avail: Univ. Microfilms Order No. 77-3594

The relationships for drag force and sinkage for a rolling, vertically-oscillating single wheel on soil as function of soil properties, tire characteristics, vertical load and forward speed were studied. The following approaches are included in this study: (1) examine and correlate available wheel-soil data which includes speed (0-95 knots) effects, (2) establish a general system model, (3) based on literature review and analysis establish strain-rate effects on soils and tires, (4) review and summarize relevant experimental and theoretical work on wheel-soil interaction, and (5) develop a method of determining the parameters required for the systems model. Dissert. Abstr.

N77-27402*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERVELOCITY IMPACT TESTS ON SPACE SHUTTLE ORBITER THERMAL PROTECTION MATERIAL
Donald H. Humes Jun. 1977 21 p refs
(NASA-TM-X-74039) Avail: NTIS HC A02/MF A01 CSCL 13M

Hypervelocity impact tests were conducted to simulate the damage that meteoroids will produce in the Shuttle Orbiter leading edge structural subsystem material. The nature and extent of the damage is reported and the probability of encountering meteoroids with sufficient energy to produce such damage is discussed. Author

N77-27403*# Rocketdyne, Canoga Park, Calif.
SMALL, HIGH-PRESSURE LIQUID OXYGEN TURBOPUMP Interim Report, Aug. 1973 - Apr. 1976
A. Csomor and R. Sutton Jul. 1977 289 p refs
(Contract NAS3-17800)
(NASA-CR-135211; R76-178) Avail: NTIS HC A13/MF A01 CSCL 13K

A small, high-pressure, liquid oxygen turbopump was

designed, fabricated, and tested. The pump was of a single-stage, centrifugal type: power to the pump was supplied by a single-stage, partial emission, axial-impulse turbine. Design conditions included an operating speed of 70,000 rpm, pump discharge pressure of 2977 N/sq cm (4318 psia), and a pump flowrate of 16.4 kg/s (36.21 lb/sec). The turbine was propelled by LO2/LH2 combustion products at 1041 K (1874 R) inlet temperature, and at a design pressure ratio of 1.424. The approaches used in the detail analysis and design of the turbopump are described, and fabrication methods are discussed. Data obtained from gas generator tests, turbine performance calibration, and turbopump testing are presented. Author

N77-27404*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SHAFT SEAL ASSEMBLY FOR HIGH SPEED AND HIGH PRESSURE APPLICATIONS Patent Application

William F. Hady and Lawrence P. Ludwig, inventors (to NASA) Filed 8 Jul. 1977 17 p

(NASA-Case-LEW-11873-1; US-Patent-Appl-SN-814006) Avail: NTIS HC A02/MF A01 CSCL 13E

A seal assembly is provided for reducing the escape of fluids from between a housing and a shaft rotatably mounted in the housing. The seal assembly comprises a pair of metallic banded carbon graphite seal rings resiliently connected to each other and disposed in side-by-side relationship. In each seal ring, both the internal bore surface and the radial face which faces away from the other seal ring are provided with a plurality of equi-spaced recesses known as Raleigh step pads. The seal faces referred to are located adjacent a seating surface of the housing. Under normal operating conditions, the seal assembly is stationary with respect to the housing. The recesses generate lift, keep the assembly spaced from the rotating shaft, and allow slip therebetween. NASA

N77-27405# Royal Aircraft Establishment, Farnborough (England).

FATIGUE STRENGTH OF JOINTS WITH SPECIAL FASTENING SYSTEMS

D. Schuetz and J. J. Gerharz 8 Feb. 1977 17 p refs Transl. into ENGLISH of "Schwingfestigkeit von Fuegungen mit Sonderbefestigungselementen", Lab. fuer Betriebsfestigkeit, TM 69/73, Darmstedt, 1973

(RAE-Lib-Trans-1914; BR58073) Avail: NTIS HC A02/MF A01

The performance of various special (fatigue resistant) fasteners was evaluated by testing under variable amplitude loading to an LBF standard spectrum for a transport aircraft wing. The fasteners were tested in three types of joint which had varying degrees of load transfer and additional bending. The results of the first phase of the test program are presented. Author

N77-27406*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN CHARTS FOR ARBITRARILY PIVOTED, LIQUID-LUBRICATED FLAT-SECTOR-PAD THRUST BEARING

Izhak Etsion Jul. 1977 60 p refs

(NASA-TN-D-8344; E-8899) Avail: NTIS HC A04/MF A01 CSCL 13I

A flat, sector-shaped geometry for a liquid-lubricated thrust bearing is analyzed considering both the pitch and roll of the pad. Results are presented in design charts that enable a direct approach to the design of point- and line-pivoted, tilting pad bearings. A comparison is made with the Mitchell bearing approximation and it is found that this approximation always overestimates load capacity. Author

N77-27407# Academy of Sciences of the Ukrainian SSR, Kiev (USSR).

THE THEORETICAL AND TECHNOLOGICAL BASES OF METAL-SURFACING

1977 114 p refs In RUSSIAN

Avail: NTIS HC A06/MF A01

The results of research in mechanized metal-surfacing processes are presented. Topics discussed include plasmic, open-arc (powder-core wire and tape), inductive, new electroslag surfacing methods, etc. The features of the heating and smelting of aftercharge materials by the new processes, the conditions for the formation of a surfaced layer, and its uniformity are studied. Information on mechanized surfacing technology and favorable areas of application for the new processes is presented. Recommendations are given concerning the selection of surfacing materials. Author

N77-27408# Arya Mehr Univ. of Technology, Teheran (Iran). Mechanical Engineering Dept.

EFFECT OF ROTOR CLEARANCE ON PRESSURE RATIO AND PUMPING SPEED OF MOLECULAR PUMP

A. E. Dabiri 26 Jul. 1977 31 p refs Backup document for AIAA Synoptic scheduled for publication in the AIAA Journal, Nov. 1977

Avail: NTIS HC A03/MF A01

The effect of rotor clearance on the pressure ratio and pumping speed of the axial flow molecular pump was investigated. The analysis was carried out for a single rotor and for a pump consisting of 10 stages. By assuming infinite blade height, large blade angle, and large spacing/chord ratios, the values of the blade angle and spacing/chord ratio become sufficient for prediction of the pressure ratio and pumping speed of the pump. However, the exact predicton of the pressure ratio and pumping speed for small values of blade angles and spacing/chord ratio must be made by considering the effect of rotor clearance. Author

N77-27409# Union Carbide Corp., Oak Ridge, Tenn. Computing Applications Dept.

UNION CARBIDE'S EXPECTATIONS OF A BOUNDED GEOMETRY PROCESSOR FOR UNCONVENTIONAL APPLICATIONS

Wesley D. Sims 1976 19 p ref Presented at CAM-I FAST-NG Special Interest Group Meeting, Dekalb, Ill., 9 Sep. 1976

(Contract W-7405-eng-26)

(K/CSD/INF-76/14; Conf-760987-1) Avail: NTIS HC A02/MF A01

The concepts and capabilities discussed are illustrated primarily from the perspective of the unconventional applications of lathe and inspection processing. They are, however, expected to have a far greater range of applicability. ERA

N77-27410# Chrysler Corp., Detroit, Mich.

BASELINE GAS TURBINE DEVELOPMENT PROGRAM Quarterly Progress Report

F. W. Schmidt and C. E. Wagner 30 Jul. 1976 50 p refs

(Contract E(11-1)-2749)

(COO-2749-15; QPR-15) Avail: NTIS HC A03/MF A01

An experimental gas turbine powered automobile was designed which would meet the 1978 Federal Emissions Standards, have significantly improved fuel economy and be competitive in performance, reliability and potential manufacturing cost with the conventional piston engine powered automobile. The baseline engine is a 4:1 pressure ratio regenerative engine with variable power turbine nozzles which meets the .41 HC, 3.4 CO, 3.0 NOx grams/mile original 1975 emissions standards. Baseline vehicles are intermediate-size, 4-door sedans modified to accept the turbine engines. Emissions tests using COED coal derived fuel were conducted. The first upgraded engine was assembled, installed in a test cell, and initial test runs up to 70% speed were conducted. Control of gas generator shaft instabilities was demonstrated by providing a low spring rate, squeeze film damping, and reducing the motion restraint caused by thrust loadings. The power turbine shaft dynamics fixture was run successfully to 60,000 rpm. ERA

N77-27411# Los Alamos Scientific Lab., N. Mex.

HIGH-RATE MECHANICAL TESTING WITH THE LASL TWO-INCH GUN

C. E. Frantz and S. S. Hecker Nov. 1976 15 p refs

(Contract W-7405-eng-36)

(LA-6528) Avail: NTIS HC A02/MF A01

A 2-in (50.8-mm) gun (TIG) that provides 25- to 125-m/s impact velocities was designed and installed. One can test sheet specimens in uniaxial or biaxial tension at strain rates as high as 60000/s and can determine deformation distribution makes load measurement impossible. Special furnace designs permit testing at temperatures as high as 1500 C. The TIG was used to test noble-metal alloys for space nuclear power systems. One established the deformation and fracture behavior of Ir-0.3%W and

Pt-30%Rh-8%W alloys at strain rates as high as 6000/s and temperatures as high as 1440 C. Simulated components of potential space nuclear power systems also were impact tested in several systems. ERA

N77-27412# Sun Oil Co., Marcus Hook, Pa. Applied Research and Development Dept.
INFRARED SPECTRA OF FLUID FILMS UNDER CONDITIONS OF INCIPIENT BEARING FAILURE, PHASE 1 Final Report, 1 Jan. 1974 - 30 Jun. 1976
James L. Lauer 1976 7 p refs
(Contract F44620-74-C-0038)
(AD-A037668; AFOSR-77-0182TR) Avail: NTIS HC A02/MF A01 CSCL 11/8

A method of analysis using infrared emission Fourier Transform Spectrophotometry was developed to study lubricant behavior under conditions of incipient bearing failure. Objectives of the research were (1) to demonstrate that infrared emission spectrophotometry can be applied to bearing contact situations, (2) to provide background in the form of calibration spectra applicable to such situations, and (3) to show the potential of the method in specific instances relevant to the failure problem. GRA

N77-27413# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
PRODUCTION SYSTEM CONFLICT RESOLUTION STRATEGIES Interim Report
J. McDermott and C. Forgy Dec. 1976 24 p refs
(Contract F44620-73-C-0074; AF Proj. 2304)
(AD-A037771; AFOSR-77-0327TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

Production systems designed to function and grow in environments that make large numbers of different, sometimes competing, and sometimes unexpected demands require support from their interpreters that is qualitatively different from the support required by systems that can be carefully hand crafted to function in constrained environments. This paper explores the role of conflict resolution in providing such support. Using criteria developed in the paper, both individual conflict resolution rules and strategies that make use of several rules are evaluated. GRA

N77-27414# IIT Research Inst., Chicago, Ill. Management and Computer Sciences Div.
MANUFACTURING METHODS REPORT: FEASIBILITY OF PRE-PROGRAMMING FOR ATLS Final Report
Robert N. Little and Charles A. Wells Sep. 1976 294 p
(Contract DAAJ01-76-C-0040)
(AD-A037681; IITRI-H6048; USAAVSCOM-76-43) Avail: NTIS HC A13/MF A01 CSCL 13/8

Preprogramming NC control tapes for ATLS (Automated Tape Layup System) using computerized methods is demonstrated to be feasible. An interactive ATLS Software System is constructed and utilized to create control information on tape which is subsequently employed to demonstrate the manufacture of fiberglass components for the CH-47FRB helicopter rotor blades. The economics of digitizing compared to preprogramming with the ATLS Software System Language are estimated, and recommendations are made for extensions to control other tape layup systems and manufacture components of different geometrical configurations. Author (GRA)

N77-27415# SKF Industries, Inc., King of Prussia, Pa.
EFFECT OF LAPPING PARAMETERS ON GENERATION OF DAMAGE ON SILICON NITRIDE BALL SURFACES Final Report, Nov. 1975 - Nov. 1976
Harish M. Dalal, J. W. Rosenlieb, and E. B. Sibley Dec. 1976 46 p refs
(Contract N00019-76-C-0147)
(AD-A037485; AL76T026) Avail: NTIS HC A03/MF A01 CSCL 13/9

This is the final report on the effect of lapping parameters on generation of damage on silicon nitride ball surfaces. Two rough lapping experiments were conducted using 44 micrometers SiC and 15 micrometers diamond abrasives in free and controlled quantities and with various unit ball loads. The results indicate that, under the test conditions chosen, diamond generates a more uniform, finer surface finish compared to the SiC and provides a larger increase in material removal rate with increase in unit ball load. Author (GRA)

N77-27416# Sikorsky Aircraft, Stratford, Conn.
THE 3000-HP ROLLER GEAR TRANSMISSION DEVELOPMENT PROGRAM. VOLUME 1: SUMMARY REPORT Final Report
G. F. Gardner and K. R. Cormier Ft. Eustis, Va. USAAMRDL Jan. 1977 68 p refs 6 Vol.
(Contract DAAJ02-69-C-0042; DA Proj. 1G1-62207-A-72)
(AD-A037308; UTRC/S611695; USAAMRDL-TR-73-98A)
Avail: NTIS HC A04/MF A01 CSCL 13/9

This report presents a summary of the 3000-HP Roller Gear Transmission Development Program. During this program a helicopter transmission employing a 19.85:1 reduction ratio roller gear unit as the final reduction stage was designed, manufactured, and subjected to extensive testing. On the basis of the results of this program, it has been determined that the roller gear is a viable concept for use in helicopter transmissions. Among the advantages it offers are compactness and high efficiency. The roller gear unit has the potential to offer weight savings over conventional type planetaries for reduction ratios greater than 12:1. The roller gear unit is, however, considerably more costly than conventional planetaries. Quality control of the electron-beam welds used in the fabrication of the roller gear components remains a problem. Detailed reports on the design, manufacture, bench testing, aircraft tiedown testing, and reliability and maintainability of the roller gear transmission have been published separately. Author (GRA)

N77-27417# Southwest Research Inst., San Antonio, Tex.
DEVELOPMENT OF DIAGNOSTIC TEST EQUIPMENT FOR INSPECTING ANTIFRICTION BEARINGS Final Report, 19 Sep. 1973 - 28 Feb. 1977
Felix N. Kusenberger and John R. Barton Mar. 1977 82 p refs
(Contracts DAAG46-74-C-0012; DAAG46-75-C-0001)
(AD-A038980; SwRI-15-3764; SwRI-15-4052; AMMRC-CTR-77-13) Avail: NTIS HC A05/MF A01 CSCL 13/9

Historical background summarizing the need for improved nondestructive inspection of antifriction bearings is presented. A state-of-the-art computer supervised semi-automated bearing inspection system is described which incorporates the magnetic perturbation method for surface and subsurface flaw detection and the Barkhausen noise method for assessing the state of stress in the active regions of the raceway. The capabilities and features of the inspection system are presented along with verification test data comparing results from a preliminary prototype unit and a prototype system. Other inspection data from used and refurbished bearing races are summarized. Metallurgical sectioning and endurance test results are included which verify the flaw detection capability of the system and establish the capability of the system to detect subsurface flaws which cause failure. Highlights of system development are also briefly summarized. Author (GRA)

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N77-27418*# Kanner (Leo) Associates, Redwood City, Calif.
AVAILABILITY AND MEAN TIME BETWEEN FAILURES OF REDUNDANT SYSTEMS WITH RANDOM MAINTENANCE OF SUBSYSTEMS
W. Schneeweiss Washington NASA Jun. 1977 19 p refs Transl. into ENGLISH from Elektron. Rechenanlagen (W. Germany), v. 6, no. 14, 1972 p 254-258
(Contract NASw-2790)
(NASA-TM-75121) Avail: NTIS HC A02/MF A01 CSCL 14D

It is shown how the availability and MTBF (Mean Time Between Failures) of a redundant system with subsystems

maintenanced at the points of so-called stationary renewal processes can be determined from the distributions of the intervals between maintenance actions and of the failure-free operating intervals of the subsystems. The results make it possible, for example, to determine the frequency and duration of hidden failure states in computers which are incidentally corrected during the repair of observed failures. Author

N77-27419*# Georgia Inst. of Tech., Atlanta.
RELIABILITY BASED FATIGUE DESIGN AND MAINTENANCE PROCEDURES Final Report
S. Hanagud 3 May 1977 54 p refs Revised
(Grant NGR-11-002-169)
(NASA-CR-145223; E16-631) Avail: NTIS HC A04/MF A01 CSCL 14D

A stochastic model has been developed to describe a probability for fatigue process by assuming a varying hazard rate. This stochastic model can be used to obtain the desired probability of a crack of certain length at a given location after a certain number of cycles or time. Quantitative estimation of the developed model was also discussed. Application of the model to develop a procedure for reliability-based cost-effective fail-safe structural design is presented. This design procedure includes the reliability improvement due to inspection and repair. Methods of obtaining optimum inspection and maintenance schemes are treated. Author

N77-27420# Los Alamos Scientific Lab., N. Mex.
HANDBOOK OF BAYESIAN RELIABILITY ESTIMATION METHODS
H. F. Martz, Jr. and R. A. Waller Nov. 1976 58 p refs
(Contract W-7405-eng-36)
(LA-6572-MS) Avail: NTIS HC A04/MF A01

Bayesian reliability estimation methods are summarized in a handbook format for convenient use by reliability practitioners. The methods given consider both attribute test data based on a binomial sampling distribution and a beta prior, a well as variables test data from an exponential sampling distribution and a gamma prior. Classical, Bayes, and empirical Bayes methods are all considered. In addition, the sample test data can arise from either an item censored life test, either with or without the replacement of failed items as they occur, or from a time runcated life test with replacement. Real data examples using nuclear reactor component failure data are used to illustrate each of the methods presented. ERA

N77-27421# Los Alamos Scientific Lab., N. Mex.
ESTIMATING AND FORECASTING FAILURE RATE PROCESSES BY MEANS OF THE KALMAN FILTER
H. F. Martz, Jr., K. Campbell, and H. T. Davis 1976 37 p refs Presented at Conf. on the Theory and Appl. of Reliability Tampa Fla., 15 Dec. 1975
(Contract W-7405-eng-36)
(LA-UR-76-41; Conf-751250-1) Avail: NTIS HC A03/MF A01

A nonparametric method is described for analyzing failure data. The approach used is to model the logarithm of the failure-rate process as a linear dynamic system with observations. This formulation permits the underlying failure-rate process to be corrupted by noise from various sources. In addition, the observations of the process are functions of simple nonparametric failure rate estimates which are assumed to be noisy. The Kalman filter equations are used to provide the estimates and future forecasts. An example is provided. ERA

N77-27422# California Univ., Livermore. Lawrence Livermore Lab.
FAULT TREES FOR LOCATION OF SENSORS IN CHEMICAL PROCESSING SYSTEMS
Howard Lambert 30 Jul. 1976 28 p refs Presented at the Am. Inst. of Chem. Engr. 69th Ann. Meeting, Chicago, 28 Nov. - 2 Dec. 1974
(Contract W-7405-eng-48)
(UCRL-78442; Conf-761109-1) Avail: NTIS HC A03/MF A01

The concepts of probabilistic importance within the context of fault tree analysis is presented. On the basis of probabilistic importance of events in fault trees, it is shown how to optimally locate sensors in a system. Two kinds of sensors are described: preventive sensors to detect early failures of critical redundant components and diagnostic sensors to detect potentially catastrophic system fault conditions. A SO2-O2 conversion process is chosen as an example to illustrate the methods that are presented. ERA

N77-27423# Failure Analysis Associates, Palo Alto, Calif.
DETERMINATION OF NONDESTRUCTIVE INSPECTION RELIABILITY USING FIELD OR PRODUCTION DATA
Duane P. Johnson Oct. 1976 31 p refs
(EPRI-NP-315; TR-8) Avail: NTIS HC A03/MF A01

The correlations between the NDI signal characteristics used in making the accept/reject decision, and the relative size (severity) of the imperfection are estimated from destructive examination of material units containing selected imperfection response amplitudes. ERA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N77-27424 Texas A&M Univ., College Station.
PLASTIC BUCKLING OF MULTI-LAYERED BEAMS Ph.D. Thesis
Shigeo Iwamura 1976 158 p
Avail: Univ. Microfilms Order No. 77-2637

Results from experimental folding of single beams of Indiana limestone (stress-strain curves and evidence of buckling instability) were used to make incremental analyses using the finite element technique. The solutions for material and geometrical nonlinear beam problems were found. Computer simulation using elastic-plastic rheology yielded a good approximation of the experimental results for single beams. Therefore, it was assumed that the method for the single layer case can be extended to multiple layers of elastic-plastic material. Dissert. Abstr.

N77-27425 Virginia Polytechnic Inst. and State Univ., Blacksburg.
STABILITY OF RETICULATED DOMES UNDER MULTIPLE STATIC AND DYNAMIC LOADS Ph.D. Thesis
Ayodele Olushola Abatan 1976 239 p
Avail: Univ. Microfilms Order No. 77-2759

The nonlinear response of the system to static loads is obtained using nonlinear programming and discrete perturbation techniques. The nonlinear programming technique is used to obtain a starting solution for the discrete perturbation technique and to optimize the choice of the perturbation parameter. Convergence criteria and error estimates to limit errors in a perturbation scheme are developed. A method for selecting a suitable perturbation parameter for imperfection sensitive systems is proposed. Dissert. Abstr.

N77-27426 North Carolina State Univ., Raleigh.
ON THE MECHANICS OF LOAD-DEFORMATION BEHAVIOR OF CRIMPED FILAMENTS Ph.D. Thesis
Dinesh Kumar Gupta 1976 246 p
Avail: Univ. Microfilms Order No. 77-2757

A second order non-linear differential equation is obtained to describe the deformed shape of a filament subjected to terminal loads in the axial direction of the crimp. The equation is solved by using MacLaurin's series expansion and is then used to describe the deformed shape and the load-elongation behavior of two dimensional crimps, such as, zig-zag crimp, gear-tooth crimp, semi-circular crimp and knit-de-knit crimp. Three first-order non-linear simultaneous differential equations are obtained which describe the deformed shape of the filament whose axes lie in three dimensional space. The finite element method is used to solve these equations to give the load-contraction relation of the three-dimensional crimp-shapes. The analysis is verified experimentally by heatsetting polyester and Nylon-6 monofilaments in different crimpshapes. Dissert. Abstr.

N77-27427*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
IMPROVED STRESS-INTENSITY FACTORS FOR SEMI-ELLIPTICAL SURFACE CRACKS IN FINITE-THICKNESS PLATES
I. S. Raju and J. C. Newman, Jr. May 1977 31 p refs Proposed for presentation at 4th Intern. Conf. on Structural Mechanics in Reactor Technol., San Francisco, 15-19 Aug. 1977
(NASA-TM-X-72825) Avail: NTIS HC A03/MF A01 CSCL 20K

Stress-intensity factors for shallow and deep semi-elliptical surface cracks in plates subjected to tension are presented. To verify the accuracy of the three-dimensional finite-element models employed, convergence was studied by varying the number of degrees of freedom in the models from 1500 to 6900. The 6900 degrees of freedom used here were more than twice the number used in previously reported solutions. Author

N77-27428*# Wiggins (J. H.) Co., Redondo Beach, Calif.
MODEL VERIFICATION OF LARGE STRUCTURAL SYSTEMS Interim Report
L. T. Lee and T. K. Hasselman Jun. 1977 121 p refs
(Contract NAS8-31950)
(NASA-CR-150317; Rept-77-1267) Avail: NTIS HC A06/MF A01 CSCL 20K

A methodology was formulated, and a general computer code implemented for processing sinusoidal vibration test data to simultaneously make adjustments to a prior mathematical model of a large structural system, and resolve measured response data to obtain a set of orthogonal modes representative of the test model. The derivation of estimator equations is shown along with example problems. A method for improving the prior analytic model is included. F.O.S.

N77-27429*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
THE USE OF A SIMPLIFIED STRUCTURAL MODEL AS AN AID IN THE STRAIN GAGE CALIBRATION OF A COMPLEX WING
Jerald M. Jenkins, Albert E. Kuhl, and Alan L. Carter Jul. 1977 19 p refs
(NASA-TM-56046; H-959) Avail: NTIS HC A02/MF A01 CSCL 14B

The use of a relatively simple structural model to characterize the load responses of strain gages located on various spars of a delta wing is examined. Strains measured during a laboratory load calibration of a wing structure are compared with calculations obtained from a simplified structural analysis model. Calculated and measured influence coefficient plots that show the shear, bending, and torsion characteristics of typical strain gage bridges are presented. Typical influence coefficient plots are shown for several load equations to illustrate the derivation of the equations from the component strain gage bridges. A relatively simple structural model was found to be effective in predicting the general nature of strain distributions and influence coefficient plots. The analytical processes are shown to be an aid in obtaining a good load calibration. The analytical processes cannot, however, be used in lieu of an actual load calibration of an aircraft wing. Author

N77-27430*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
A STUDY OF THE EFFECT OF RADICAL LOAD DISTRIBUTIONS ON CALIBRATED STRAIN GAGE LOAD EQUATIONS
Jerald M. Jenkins and Albert E. Kuhl Jul. 1977 34 p refs
(NASA-TM-56047; H-984) Avail: NTIS HC A03/MF A01 CSCL 20K

For several decades, calibrated strain gages have been used to measure loads on airplanes. The accuracy of the equations used to relate the strain gage measurements to the applied loads has been based primarily on the results of the load calibration. An approach is presented for studying the effect of widely varying load distributions on strain gage load equations. The computational procedure provides a link between the load calibration and the load to be measured in flight. A matrix approach to equation selection is presented, which is based on equation standard error, load distribution, and influence coefficient plots of the strain gage equations, and is applied to a complex, delta-wing structure. Author

N77-27431*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODE I ANALYSIS OF A CRACKED CIRCULAR DISK SUBJECT TO A COUPLE AND A FORCE
Bernard Gross 1977 15 p refs
(NASA-TM-73692; E-9228) Avail: NTIS HC A02/MF A01 CSCL 20K

Mode 1 stress intensity coefficients were obtained for an edge-cracked disk (round compact specimen). Results for this plane elastostatic problem, obtained by a boundary collocation analysis are presented for ratios 0.35 less than A/D less than 1, where A is the crack length and D is the disk diameter. The results presented are for two complementary types of loading. By superposition of these results the stress intensity factor K sub I for any practical load line location of a pin-loaded round compact specimen can be obtained. Author

N77-27432*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LIGHTWEIGHT STRUCTURAL COLUMNS Patent Application
Harold G. Bush, inventor (to NASA) Filed 29 Jun. 1977 17 p
(NASA-Case-LAR-12095-1; US-Patent-Appl-SN-811401) Avail: NTIS HC A02/MF A01 CSCL 13M

Lightweight half-lengths of columns for truss structures were designed that are adapted for nestable storage and transport to facilitate fabrication of large area truss structures at a remote site. The design would be particularly adaptable for space applications. NASA

N77-27433# State Univ. of New York, Stony Brook. Dept. of Materials Science.
APPLICATIONS OF MICRODYNAMICS AND LATTICE MECHANICS TO PROBLEMS IN PLASTIC FLOW AND FRACTURE Progress Report, 1 Jan. - 31 Dec. 1976
John C. Bilello and John M. Liu 1976 28 p refs
(Contract EY-76-S-02-3476)
(COO-3476-14) Avail: NTIS HC A03/MF A01

The temperature dependence of crack propagation in molybdenum single crystals, on a theoretical investigation of screw dislocations via lattice dynamic methods and on the crystal growth of niobium-molybdenum alloys was experimentally studied. Cleavage observations at 77 K for 100 oriented molybdenum crystals revealed significant plastic relaxation at the crack-tip. Raising the temperature to 298 K causes slow crack growth to occur, but only when the macroscopic proportional limit is exceeded. The implications of these findings with respect to cleavage energetics is discussed. Lattice dynamics calculations on a model crystal have determined the local optical mode frequencies and inelastic neutron scattering cross section for screw dislocation arrays. A method of assessing the screw dislocation core energy from such data is indicated. Finally a series of Nb-Mo alloy crystals of homogeneous composition and controlled microstructure have been produced. ERA

N77-27434# Oak Ridge National Lab., Tenn.
STRESS ANALYSES OF PERFORATED FLAT PLATES UNDER IN-PLATE LOADINGS
J. P. Callahan and J. W. Bryson 28 Jun. 1976 66 p refs
(Contracts W-7405-eng-26; NRC-INA-40-495-75)
(ORNL-NUREG-2) Avail: NTIS HC A04/MF A01

Strain gaged flat plates having one, two, three, and five closely spaced holes were tested under uniaxial and 1:1 biaxial loading conditions. The experimental results of the tests were compared with corresponding calculated values obtained using the computer program TABLES. The study was conducted (1) to obtain highly reliable experimental data that can be used in the design of penetrations in vessels having large radii of curvature, (2) to evaluate the capability of the computer program TABLES for accurately predicting the stresses in perforated flat plates, (3) to complete the initial step leading toward the planned development of a method of analysis for clusters of nozzles attached to pressure vessels, and (4) to investigate the stress

states in regions of closely space holes. The comparisons of calculated and experimental stresses were in good agreement, and the method of analysis was found to be capable of accurately predicting the complex state of stress in the vicinity of the closely spaced holes. ERA

N77-27435# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CREEP OF CONCRETE UNDER VARIOUS TEMPERATURE, MOISTURE, AND LOADING CONDITIONS
J. E. McDonald 1976 31 p refs Presented at Amer. Concrete Inst. Conv., Mexico City, Mex., 24 Oct. 1976
(Contract E(40-1)-4128)
(CONF-761036-1) Avail: NTIS HC A03/MF A01

An investigation was conducted to obtain information on the time dependent deformation behavior of concrete in the presence of temperature, moisture, and loading conditions similar to those encountered in a prestressed concrete reactor vessel (PCRV). Variables included concrete strength, aggregate types, curing history, temperature, and types of loading (uniaxial, hydrostatic, biaxial, and triaxial). There were 66 test conditions for creep tests and 12 test conditions for unloaded or control specimens. Experimental results are presented and discussed. Comparisons are made concerning the effect of the various test conditions on the behavior of concrete, and general conclusions are formulated. ERA

N77-27436# Sandia Labs., Albuquerque, N. Mex.
THIN FILM ADHESION AND ADHESIVE FAILURE: A PERSPECTIVE
D. M. Mattox 1976 14 p refs Presented at the ASTM Conf. on Adhesion Meas. of Thin Films, Thick Films, and Bulk Coatings, Philadelphia, 2-4 Nov. 1976
(Contract E(29-1)-789)
(SAND-76-5946; Conf-761119-1) Avail: NTIS HC A02/MF A01

The failure mode of chemical and mechanical bonding across the interfacial region was investigated. Adhesion testing must take into account the possible deformation and fracture modes, and a testing program must be devised to test all aspects of adhesion. ERA

N77-27437*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MULTIAXIAL CREEP-FATIGUE LIFE ANALYSIS USING STRAINRANGE PARTITIONING
S. S. Manson (Case Western Reserve Univ.) and G. R. Halford Nov. 1976 51 p refs Presented at Ann. Meeting of Am. Soc. Mechan. Eng., New York, Dec. 1976
(Contract W-7405-eng-26)
(NASA-TM-74756; Conf-761107-3) Avail: NTIS HC A04/MF A01 CSCL 13M

The method to treat multiaxiality through a set of rules for combining the strain components in the three principal directions is presented. Closed hysteresis loops, as well as plastic and creep strain ratcheting, are included. An application to holdtime tests in torsion is used to illustrate the approach. ERA

N77-27438# Sandia Labs., Albuquerque, N. Mex.
USE OF VARIOUS RATES OF STRESS INCREASE IN PROGRESSIVE STRESS TESTING
D. H. Loescher, T. M. Snowden (GE Co., St. Petersburg, Fla.), and H. F. Zuhr (GE Co., St. Petersburg, Fla.) 1976 22 p refs Presented at the Conf. on Elec. Insulation, Buck Hill Falls, Pa., Oct. 1976
(Contract E(29-1)-789)
(CONF-761050-1) Avail: NTIS HC A02/MF A01

A statistical model is developed for progressive stress testing of insulation. It is shown that results from a series of tests for various rates of stress increase can be used to determine if the failure rate of the insulation system is proportional to V/sup a/t/sup b/. Data show that the aging of Mylar capacitors subjected to dc stress is not in accord with the V/sup a/t/sup b/ law. In fact, tests at various rates of voltage increase provide evidence for a conditioning process that competes with the aging process. For a group of capacitors with two layers of insulation the median failure voltage increased from 12.9 kV dc for stress increasing at 400 V/s to 15.6 kV for stress increasing at 0.4 V/s. ERA

N77-27439# Battelle Columbus Labs., Ohio.
RESIDUAL STRESSES AT GIRTH-BUTT WELDS IN PIPES AND PRESSURE VESSELS Quarterly Progress Report, 15 Jul. - 15 Oct. 1976
E. F. Rybicki, D. W. Schmueser, J. J. Groom, M. M. Lemcoe, H. W. Mishler, and E. C. Rodabaugh Oct. 1976 51 p refs
(Contract AT(49-24)-0293)
(BMI-NUREG-1958; NRC-5) Avail: NTIS HC A04/MF A01

A progress summary is presented for a combined experimental and analytical study to develop mathematical models for predicting residual stresses in girth-butt welds. Specific analytical models for predicting temperature distributions and residual stresses are identified. Preliminary calculations with the temperature model showed good correlation with experimental data. The mathematical representation for predicting stress distributions in welded joints is in early stages of development. The model recognizes individual weld passes, distortions, and stresses due to each weld pass, temperature dependent material properties, elastic-plastic stress-strain behavior, and elastic stress-strain unloading from an elastic-plastic state of stress. Preliminary checks on the stress analysis model successfully demonstrated its capability to handle unloading. Residual strains are obtained by placing gages on the pipe after the test. The gages are cut out and the change in strain is recorded. This strain is attributed to the residual stress in the material. ERA

N77-27440# Hanford Engineering Development Lab., Richland, Wash.
NASTRAN NONLINEAR DYNAMIC TRANSIENT ACCIDENT ANALYSIS FOR FFTF REACTOR COMPONENT
R. A. Lujan, D. M. Chenault, and J. C. Go 1976 9 p refs Presented at ANS Winter Meeting, Washington, D. C., 15 Nov. 1976
(Contract EY-77-C-14-2170)
(HEDL-SA-877; Conf-761103-24) Avail: NTIS HC A02/MF A01

A nonlinear dynamic transient analysis merging hand calculations and the NASTRAN structural analysis computer code was conducted for a Fast Flux Test Facility in-reactor test assembly during an extremely unlikely design basis accidental event which is considered a Hypothetical Core Disruptive Accident (HCDA). The finite element modeling of the problem took advantage of NASTRAN's versatility to create loads and nonlinear elements not previously found in NASTRAN's library. The structural criteria for the test assembly to withstand an HCDA stipulates that the test assembly and its spoolpiece shall remain integral with the reactor head such that missiles are not generated. ERA

N77-27441# Failure Analysis Associates, Palo Alto, Calif.
STUDY OF CRACK GROWTH UNDER OPERATIONAL CONDITIONS IN STEAM TURBINE STEEL: PHASE 1 REPORT
I. Roman, C. A. Rau, A. S. Tetelman, and K. Ono Jul. 1976 54 p refs Sponsored by EPRI
(EPRI-NP-325; TR-9) Avail: NTIS HC A04/MF A01

Fatigue crack growth and plane strain fracture toughness have been examined in three 1 Cr-Mo-V bainitic steam generator rotor steels. The effects of inclusion content, manufacturing processes, and repeated aging on the rate of subcritical crack growth at room temperature have been investigated using compact tension specimens. The impact properties of these steels above the temperature range of -62 - +100 C have also been determined using both standard and precracked Charpy specimens. In addition the tensile properties above the temperature range of 0 to 538 C have been evaluated using cylindrical tensile specimens. ERA

N77-27442# MARC Analysis Research Corp., Palo Alto, Calif.
THREE-DIMENSIONAL ELASTIC-PLASTIC STRESS AND STRAIN ANALYSES FOR FRACTURE MECHANICS: COMPLEX GEOMETRICS
Herbert J. Bellucci Nov. 1975 67 p refs
(Contracts W-7405-eng-26; NRC-INA-40-495-75)
(ORNL-Sub-3821-1; Rept-09177; TR-75) Avail: NTIS HC A04/MF A01

A method for generating crack tip elements was developed and a model was created for a cylindrical pressure vessel with a nozzle and an imbedded flaw at the inside nozzle corner. The

MARC-3D program was again used to analyze this flawed model. ERA

N77-27443# Argonne National Lab., Ill. Materials Science Div.

DAMAGE EQUATION FOR CREEP-FATIGUE INTERACTION

S. Majumdar and P. S. Maiya 1976 29 p refs Presented at the ASME Symp. on Creep Fatigue Interaction, New York, 6-10 Dec. 1976

(Contract W-31-109-eng-38)

(CONF-761107-21) Avail: NTIS HC A03/MF A01

A damage equation for creep-fatigue interaction is proposed. Instead of separating total plastic strain into time dependent and time independent components or using frequency as the controlling parameter, the problem is cast in terms of the total plastic strain and strain rate as the fundamental variables. The damage equation can be integrated to analyze the time to failure for creep and creep-fatigue loading. The method is illustrated for Types 304 and 316 austenitic stainless steel, Incoloy 800 and 2-1/4 Cr-1 Mo steel at various temperatures. Certain simplification can be made so that the method is attractive to designers of structures operating at elevated temperatures and loadings which do not necessarily involve a closed hysteresis loop type loading. ERA

N77-27444# Sandia Labs., Albuquerque, N. Mex. Simulation Research Dept.

STATIC TESTS OF ENERGY-ABSORBING CHARACTERISTICS OF 304 STAINLESS STEEL FINS

Mathias J. Sagartz Nov. 1976 19 p refs

(Contract E(29-1)-789)

(SAND-76-0633) Avail: NTIS HC A02/MF A01

Four stainless steel specimens representative of possible fin configurations on a shipping cask for spent reactor fuel rods were tested to determine their potential usefulness as part of the cask impact limiter system. The specimens included a simple straight fin, a fin with thin periodic lateral stiffeners, a fin with larger lateral stiffeners and a cylindrical shell whose axis is normal to the cask surface. Results in the form of load-deflection curves show that the addition of lateral stiffeners can greatly enhance the fin's energy absorbing capability. The cylindrical specimen was by far the most efficient, absorbing more than twice as much energy per unit volume as any of the other specimens. ERA

N77-27445# Michigan Dept. of State Highways and Transportation, Lansing. Testing and Research Div.

FRACTURE TOUGHNESS AND FATIGUE PROPERTIES OF STEEL PLATE BUTT JOINTS WELDED BY SUBMERGED ARC AND ELECTROSLAG WELDING PROCEDURES Final Report, 1972 - 1976

James D. Culp May 1976 136 p refs

(PB-264296/5; FHWA-R-1011) Avail: NTIS HC A07/MF A01 CSCL 13E

Welded butt joints, typical of those used in the flanges of steel plate girders, were welded by electroslag and submerged arc processes in steel plates. The electroslag weldments were made by the consumable guide method using both the water cooled and non-cooled retaining shoes. Complete metallurgical studies were done on the weldments to define and document the various weld metal and heat-affected zones that were present. Chemical compositions of the various weldment zones are presented and discussed. GRA

N77-27446# Texas Transportation Inst., College Station.

LOW TEMPERATURE TRANSVERSE CRACKING OF ASPHALT CONCRETE PAVEMENTS IN CENTRAL AND WEST TEXAS Final Report

Paul E. Benson Sep. 1976 72 p refs Sponsored in part by Texas State Dept. of Highways and Public Transportation and Federal Highway Administration

(PB-264641/2; TTI-2-9-72-175-2F; RR-175-2F; FHWA-RD-M-0352) Avail: NTIS HC A04/MF A01 CSCL 13C

An evaluation of the relation between asphalt hardening, thermal forces and pavement cracking in Texas is made. Thermally induced cracking of hardened pavements is found to be a potential failure mechanism. Factors affecting asphalt hardening susceptibility are studied. The form of a generalized model for predicting hardening of asphalt as a function of time is proposed. GRA

N77-27447# Kaman Avidyne, Burlington, Mass.

DEPROP: A DIGITAL COMPUTER PROGRAM FOR PREDICTING DYNAMIC ELASTIC-PLASTIC RESPONSE OF PANELS TO BLAST LOADINGS Final Report, 14 Jan. - 29 Jun. 1976

Lawrence J. Mente and William N. Lee Eglin AFB, Calif. AFATL Jun. 1976 201 p refs

(Contract F08635-76-C-0162; AF Proj. 2549)

(AD-A035644; KA-TR-133; AFATL-TR-76-71) Avail: NTIS MF A01 CSCL 01/3

The DEPROP digital computer program determines the dynamic elastic-plastic, large displacement response of cylindrical and flat panels to arbitrary blast loadings. The program computes strain, stress, displacement and boundary reaction force time histories for linear elastic and elastic-plastic solution options. The theoretical formulation and program description of DEPROP are presented in the form of a User's Manual. Author (GRA)

N77-27448# California State Univ., Long Beach. Dept. of Civil Engineering.

EXPERIMENTAL STUDIES OF FATIGUE FAILURES OF DOWN LEAD CABLES Final Report

C. V. Chelapati, J. M. Plecnik, and J. Cunningham Dec. 1976 33 p

(Contract N68305-76-C-0015)

(AD-A037164; CEL-CR-77.010) Avail: NTIS HC A03/MF A01 CSCL 13/5

Eight hard drawn copper cables were tested to failure under static lateral axial load and either dynamic lateral load or torsional couple. Due to the large number of test parameters involved and the limited number of specimens tested, firm conclusions cannot be drawn about the fatigue life of copper cables under dynamic lateral or torsional loading combined with axial tension. With axial and lateral load, fatigue failure occurred at 4,000 cycles; with axial and torsional load, failure occurred at about 10,000 cycles. Author (GRA)

N77-27449# Illinois Univ., Urbana-Champaign. Dept. of Civil Engineering.

NONLINEAR ANALYSIS OF INTERSECTING CYLINDERS BY THE FINITE ELEMENT METHOD

Hsing-Chang Chen and William C. Schnobrich Dec. 1976 143 p refs

(Contract N00014-75-C-0164; NR Proj. 064-183)

(AD-A037242; SRS-435; UILU-ENG-76-2026) Avail: NTIS HC A07/MF A01 CSCL 13/4

A finite element procedure is presented for the analysis of intersecting cylinders with elastic-plastic behavior. A special layered system is utilized in the region of the intersection where the high stress gradient exists while two-dimensional curved shell elements are used throughout the remainder of the structure, this to minimize computational efforts. A problem of two normally intersecting cylinders under internal pressure is solved. The stresses at the outer and inner fibers of the shells are evaluated and compared with available experimental data. It is found that yielding starts from the region where the two cylindrical walls intersect perpendicularly, then spreads out along the intersection line with increased load. Author (GRA)

N77-27450# Naval Civil Engineering Lab., Port Hueneme, Calif.

FLANGED ACRYLIC PLASTIC HEMISPHERICAL SHELLS FOR UNDERSEA SYSTEMS. STATIC AND CYCLIC FATIGUE LIFE UNDER HYDROSTATIC LOADING Final Report, Jul. 1973 - Jun. 1975

J. D. Stachiw and R. Slettin Jan. 1977 110 p refs

(YF5493008)

(AD-A036961; CEL-TN-1468) Avail: NTIS HC A06/MF A01 CSCL 13/10

Twenty-four acrylic plastic windows in the shape of hemispherical domes with equatorial flanges have been thermoformed from flat sheets and tested under short-term, long-term, and cyclic pressure loading at 65 to 75 F (18.5 to 24.1 C ambient temperature. Two kinds of flanges were studied; Type I, a flat lip with a rounded heel and instep, and Type VI, a conical lip

with a rounded heel. The 14,500-psi, short-term critical pressure for hemispn either case, the maximum acceptable working pressure for 65 to 75 F temperature range was found to be 1,000 psi. Only by elimination of the O-ring groove in the bearing surface of the window flange and the use of a thin neoprene bearing gasket between the acrylic flange and the steel seat is it possible to extend the working pressure for 65 to 75 F 18.5 to 24.1 C temperature range to 2,000 psi. Operating the flanged windows at pressures in excess of the safe working pressures shown above will generate fatigue cracks in the bearing surface of the flange in less than 1,000 pressure cycles at 5,000-psi pressure the cyclic fatigue life decreases to less than 100 cycles.

Author (GRA)

N77-27451# Northwestern Univ., Evanston, Ill. Dept. of Industrial Engineering and Management Sciences.

OPTIMAL MASS SCREENING UNDER CONSTANT AND THRESHOLD TEST RELIABILITIES

William P. Pierskalla and John A. Voelker (Montgomery Ward Co.) Mar. 1977 42 p refs

(Contracts N00014-67-A-0356-0030; N00014-75-C-0797)

(AD-A038258; TR-5) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper considers a population (composed, for example, of people, machines, or livestock) subject to a randomly occurring defect or disease. If there exist testing procedures capable of detecting the defect before it would otherwise become known, and if such early detection provides benefit, the periodic administration of such a test procedure to the members of the population, i.e., a mass screening program, may be advisable. This paper develops and analyzes two important cases of a general model of a mass screening program. In both cases, the defect arrival process is Poisson. In the first case, the reliability of the test, i.e., the probability that the test will detect the disease, is dependent only on the type of test being administered and is constant over all values of elapsed time since the incidence of the defect. The long-run expected disutility per unit time is derived and variations of the disutility with regard to test reliability and testing frequency are presented. In addition, explicit solutions are provided for various special forms of the disutility function. In the second case, the test will detect the defect if and only if the elapsed time since incidence exceeds a critical threshold T which characterizes the test. An expression for the long-run expected disutility per unit time is derived and decision rules to select between two alternative test types and costs are presented. Author (GRA)

N77-27452# Holosonics, Inc., Richland, Wash.

AN EVALUATION OF REAL AND PROGRAMMED DEFECT CONDITIONS IN HIP DISCS USING HOLOSONICS' SYSTEM 200 SCANNED ACOUSTICAL HOLOGRAPHY IMAGING SYSTEM Final Report, 13 Jun. 1975 - Jun. 1976

N. J. Knuter Jun. 1976 147 p

(Contract DAAJ01-75-C-0896)

(AD-A038264; USAAVSCOM-TR-76-25) Avail: NTIS HC A07/MF A01 CSCL 14/2

This report documents the successful inspection of HIP discs using Holosonics' System 200 Scanned Acoustical Holography Inspection System. The System 200 provides hard copy photographic images of internal material structural conditions. These acoustical images photos depict plan view, section view, 3-D projected views and reconstructed acoustical holography images of both real and programmed anomalous conditions within the HIP discs provided for this study. A total of 13 test specimens containing both real and programmed defects were examined in order to provide a meaningful data presentation documenting the adaptability of the System 200 to production inspection of HIP discs. A recommended system configuration is presented in the conclusion of this report. Author (GRA)

N77-27453# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Concrete Lab.

DURABILITY AND BEHAVIOR OF PRESTRESSED CONCRETE BEAMS. NO. 4: POST-TENSIONED CONCRETE BEAM INVESTIGATION WITH LABORATORY TESTS FROM JUNE 1961 TO SEPTEMBER 1975

Edward F. ONeil Feb. 1977 177 p refs

(AD-A038444; WES-TR-6-570-4) Avail: NTIS HC A09/MF A01 CSCL 13/13

This report is the fourth in a series describing a study which is being conducted to develop information on the durability of prestressed concrete beams. Twenty post-tensioned concrete beams were cast and installed at the Treat Island exposure station. The beams were cast around four different types of post-tensioning systems, with the post-tensioning reinforcement cast at four different eccentricities. Twelve different types of end anchorage protection were cast over external and flush anchorages. The end anchorage protection was attached to the beam with four different types of joint preparation. The beams were subjected to tidal inundations (wetting and drying) two times each day and also to an average of 131 cycles of freezing and thawing per winter for a test period of 12 to 13 winters. During the fall of 1973, five beams were returned to the U.S. Army Engineer Waterways Experiment Station for autopsy and testing. The testing included: (a) structural testing, visual evaluation of the condition, and dissection of the concrete beams; (b) visual evaluation of the end anchorages and the post-tensioning conduit; (c) autopsy of the posttensioning system; (d) structural testing of the post-tensioning strands; (e) analysis of the products of corrosion on the steel strands; and (f) analysis of the concrete and grout of the beams. GRA

N77-27454# Oakland Univ., Rochester, Mich. School of Engineering.

ON THE INTERPRETATION OF SHADOW-MOIRE FRINGES

J. Buitrago and A. J. Durrelli Apr. 1977 40 p refs

(Contract N00014-76-C-0487)

(AD-A038844; Rept-42) Avail: NTIS HC A03/MF A01 CSCL 20/11

Shadow-Moire is presented as one of several means of determining loci of constant height in curved surfaces (isotathmics). A general expression to interpret the fringes is derived taking into consideration possible rotations and translation of the grating. A discussion of the influence of such rotations and translation on the sensitivity of the response if also presented. Furthermore, simplified equations are obtained for particular cases of practical interest. An example of application to the case of an inverted perforated tube is shown. Author (GRA)

N77-27455# National Bureau of Standards, Washington, D. C.

CHARACTERIZING THE INTER-FIBER BOND STRENGTHS OF PAPER PULPS IN TERMS OF A BREAKING ENERGY Progress Report, 1 Jan. - 30 Jun. 1976

Jack C. Smith and Edmond L. Graminski 15 Oct. 1976 40 p refs Sponsored by ERDA

(PB-264689/1; NBSIR-76-1148) Avail: NTIS HC A03/MF A01 CSCL 11L

It has been postulated that a measure of bond strength can be obtained by measuring 2.5 g/sq m handsheets to tensile failure, recording the number of bonds broken with a sensitive tensile tester and plotting a curve of number of bonds broken as a function of cumulative work done on the system. The value of the minimum slope of this curve is equal to the average energy dissipated per bond break. Results obtained on two different softwood kraft pulps indicate the proposed method may be useful in assessing bond strengths. GRA

N77-27456# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Renewable Resources for Industrial Materials.

RENEWABLE RESOURCES FOR STRUCTURAL AND ARCHITECTURAL PURPOSES

James S. Bethel 1976 199 p refs

(Grant NSF STP-75-10169)

(PB-264538/0; NSF/PRA-7501069/6/7) Avail: NTIS HC A09/MF A01 CSCL 11L

Emphasis is given to renewable resources that, in primary processed form, are characterized by reliably known physical and mechanical properties and are dimensionally suitable for structural use. The processing of raw materials from the forest into prisms and rigid panels, which can in turn be fabricated into engineered and architecturally designed structures, and the flow of these materials into selected building components are studied. GRA

N77-27457# Mississippi Univ., University. Dept. of Civil Engineering.
CRITERIA FOR EMULSIFIED ASPHALT STABILIZATION OF SANDY SOILS IN MISSISSIPPI Interim Report
K. P. George Oct. 1976 107 p refs Sponsored by DOT and Mississippi State Highway Dept.
(PB-265168/5; FHWA-M-0351) Avail: NTIS HC A06/MF A01 CSCL 13C

The results show that well graded sands with sufficient silt-clay material respond well to emulsions. Portland cement in trace quantities is required, however, to improve the water-susceptibility of the mixture. Because of its superior bonding to silicious aggregate, cationic emulsion is preferred in sand stabilization. Making use of the test results on eight naturally occurring soils and one synthetic aggregate mix design criteria for sands and sandy soils is proposed. Mixtures which strip or stiffen excessively on mixing may be unsatisfactory. In addition, a mixture will be considered suitable. GRA

N77-27458# Colorado Div. of Highways, Denver. Planning and Research Section.
REFLECTION CRACKING IN BITUMINOUS OVERLAYS Final Report, 1971-1976
Denis E. Donnelly, Philip J. McCabe, and Herbert N. Swanson Dec. 1976 80 p refs Sponsored by Federal Highway Admin. (PB-265456/4; CDOH-P/R-R-76-6; FHWA-CO-RD-76-6) Avail: NTIS HC A05/MF A01 CSCL 13D

Nine different treatments to the pavement were included in the design of an Interstate project in Colorado in anticipation of finding a method of reducing or eliminating reflection cracking through bituminous overlays. Each treatment is represented by two 1,000 feet (305 meter) long sections, and there were two standard sections which were used as a basis for comparison. The major item of work included was a leveling course and a 2 inch (5 cm) overlay of an existing 3 inch (8 cm) bituminous pavement which brought this section of Interstate 70 to full standard design thickness. The linear cracking in the eight year old pavement before the overlay was placed average 41 feet (12.5 meters) per 1,000 square feet (93 square meters) and the alligator cracking averaged 36 square feet (3.3 square meters) per 1,000 square feet (93 square meters) of test section. Construction of the test sections began in September and was completed in October 1971. The treatments listed in the order of their performance for reducing reflective cracking were: petromat (polyethylene fabric), slurry seal, rubberized asphalt, reclamite, petroset, hand poured, heat-scarifier, plant mixed seal, squeegee seal, and standard (no treatment). GRA

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography*.

N77-27459 Kansas Univ., Lawrence.
ANALYSIS OF ERROR IN GROUNDWATER MODELLING Ph.D. Thesis
Mehmet Arif Yukler 1976 194 p
Avail: Univ. Microfilms Order No. 77-2297

An equation was derived for the case of unconfined groundwater flow which more accurately describes the movement of the free surface. This is an approximation to the three-dimensional flow systems. A new method using sensitivity coefficients was developed to analyze the errors in hydraulic head values due to errors in hydraulic conductivity, specific yield, storage coefficient, and transmissivity. A direct, closed form of the sensitivity equation was obtained. The groundwater flow and the sensitivity equations were applied to west-central Kansas Pliocene aquifer. It was concluded that (1) Darcy's law is valid in modelling of large groundwater systems where the velocity of flow is averaged over a large areas; (2) dependence of transmissivity on time can be neglected; (3) The storage coefficient can be assumed independent of time and space if the formation compacts less than 5% of its original thickness; and (4) Dupuit-Forchhemier assumptions are valid for large groundwater systems. Dissert. Abstr.

N77-27460 Kansas Univ., Lawrence.
EXAMINATION AND ANALYSIS OF VEGETATION BOUNDARY ZONES USING AERIAL AND ORBITAL DATA SOURCES Ph.D. Thesis
Norman Edward Hardy 1976 124 p
Avail: Univ. Microfilms Order No. 77-2221

Parts of four areas; Texas, Kansas, Wyoming and Alberta, have been selected as test sites. Environmental variations have been shown to exist between the four independent test areas. Climates, geology, soils and vegetation have been discussed at length and variations between sites have been considered. Dissert. Abstr.

N77-27461 California Univ., Los Angeles.
WOODY VEGETATION PATTERNS IN THE CONIFEROUS FOREST ZONE OF THE SOUTHERN SIERRA NEVADA Ph.D. Thesis
Paul Harvey Leskinen 1976 239 p
Avail: Univ. Microfilms Order No. 77-1643

The composition of various types of woody vegetation under different ecological conditions in the Southern Sierra Nevada was compared. Open slope vegetation in two traverses across the Sierra was sampled in a series of short transects grouped around stations at 500 foot (150 m) contour intervals. It was found that altitudinal zonation is not well defined in the Southern Sierra Nevada. Overall the most significant changes in vegetation occur from east to west at any given altitude, rather than from north to south, with climate, topography, the frequency of lightning fires, and, to a minor extent, lithology as the main environmental variables. There is no way to handle properly the spatial distribution of the woody plant species in terms of the traditional 'association.' Selection of dominant species would be purely arbitrary. The various plant species are present in response to individual edaphic and climatic requirements. Dissert. Abstr.

N77-27462 Wisconsin Univ., Madison.
THEORETICAL AND PRACTICAL RELATIONSHIPS BETWEEN REMOTE SENSING AND CARTOGRAPHY Ph.D. Thesis
Arthur Jon Kimerling 1976 309 p
Avail: Univ. Microfilms Order No. 76-25566

A limited version of a system which combines remote sensing and cartography into a single improved strategy for handling geographic information was developed which in expanded form could serve as a prototype for digitally based thematic mapping systems. The model utilizes a local smoothing operator which is iterative and frequency based to simplify nominal level classified data. A thorough statistical comparison of vegetation maps of the same area created through application of traditional manual methods and produced by these two means increases with each simplification iteration. Guidelines as to the number of iterations, neighborhood size, and reclassification threshold needed to satisfactorily simplify classified data were also determined. The results of this modern mapping experiment illustrate the close relationship that exists between the two fields at the present time and demonstrate the need to combine remote sensing and cartographic activities. Dissert. Abstr.

N77-27463 Kansas Univ., Lawrence.
VARIABILITY OF THE ACCURACY OF DELINEATING AGRICULTURAL FIELD BOUNDARIES FROM SATELLITE IMAGES OF THE UNITED STATES Ph.D. Thesis
David Eugene Schwarz 1976 204 p
Avail: Univ. Microfilms Order No. 77-2275

A study of agricultural land use and its interpretation from satellite images indicates that the same level of accuracy of

agricultural land use data cannot be extracted from comparably high quality satellite images from diverse environments in the southern United States. The agricultural landscapes were analyzed in terms of the interpretability of the primary segments which compose them- agricultural fields or their equivalent, such as woodlots. The degree to which interpreted field boundaries conformed with actual field boundaries was evaluated both qualitatively and quantitatively, including optical data processing. Dissert. Abstr.

N77-27464 Purdue Univ., Lafayette, Ind.
DIGITAL PROCESSING OF SATELLITE MULTISPECTRAL SCANNER DATA FOR HYDROLOGIC APPLICATIONS Ph.D. Thesis
Luis Alberto Bartolucci-Castedo 1976 251 p
Avail: Univ. Microfilms Order No. 77-1682

The development of computer-aided procedures to extract useful hydrologic information from satellite digital multispectral data for applications to surface water inventory and snowcover mapping in mountainous regions is presented. LANDSAT MSS and SKYLAB S-192 multispectral data were utilized. The results indicated that the smallest water body that can be reliably identified using computer-aided multispectral classification of LANDSAT data should be at least three hectares (approximately equal to or larger than 8 acres in size). Smaller water bodies can be identified only in particular cases in which at least one spatial resolution entirely covers the water surface. Use of a mixture spectral class, however, allows reliable identification of water bodies as small as one hectare (approximately equal to 2.5 acres) in size. Dissert. Abstr.

N77-27465*# Agricultural Research Service, Weslaco, Tex.
SOIL, WATER, AND VEGETATION CONDITIONS IN SOUTH TEXAS Final Report, 13 Jan. 1975 - 13 Jun. 1977
Craig L. Wiegand, Harold W. Gausman, Ross W. Leamer, Arthur J. Richardson, James H. Everitt, and Alvin H. Gerbermann, Principal Investigators Jun. 1977 120 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-53876-AG)
(E77-10175; NASA-CR-153273) Avail: NTIS HC A06/MF A01 CSCL 08F

The author has identified the following significant results. The best wavelengths in the 0.4 to 2.5 micron interval were determined for detecting lead toxicity and ozone damage, distinguishing succulent from woody species, and detecting silverleaf sunflower. A perpendicular vegetation index, a measure of the distance from the soil background line, in MSS 5 and MSS 7 data space, of pixels containing vegetation was developed and tested as an indicator of vegetation development and crop vigor. A table lookup procedure was devised that permits rapid identification of soil background and green biomass or phenological development in LANDSAT scenes without the need for training data.

N77-27466*# Colorado School of Mines, Golden.
REMOTE SENSING OF GEOLOGIC MINERAL OCCURRENCES FOR THE COLORADO MINERAL BELT USING LANDSAT DATA Final Report, 1 Jul. 1975 - 30 Sep. 1976
Robert H. Carpenter, Principal Investigators and David W. Trexler 30 Sep. 1976 161 p refs ERTS
(Contract NAS5-20955)
(E77-10176; NASA-CR-153274) Avail: NTIS A08/MF A01 CSCL 08G

The author has identified the following significant results. LANDSAT imagery was examined as a practical and productive tool for mineral exploration along the Colorado Mineral Belt. An attempt was made to identify all large, active and/or abandoned mining districts on the imagery which initially were discovered by surface manifestations. A number of strong photolinements, circular features, and color anomalies were identified. Some of these form a part of the structural and igneous volcanic framework in which mineral deposits occur. No specific mineral deposits such as veins or porphyries were identified. Promising linear and concentric features were field checked at several locations. Some proved to be fault zones and calderas; others were strictly topographic features related to stream or glacial entrenchment. The Silverton Caldera region and the Idaho Springs-Central City district were chosen and studied as case histories to evaluate the application of LANDSAT imagery to mineral exploration. Evidence of specific mineralization related to ore deposits in these two areas were observed only on low level photography.

N77-27467*# Earth Satellite Corp., Washington, D.C.
FOREIGN LANDSAT STATION CHARGE STUDY Monthly Progress Report, 1-30 Apr. 1977
Charles Sheffield, Principal Investigator 2 May 1977 9 p refs ERTS
(Contract NASw-3033)
(E77-10177; NASA-CR-153275) Avail: NTIS HC A02/MF A01 CSCL 05B

There are no author-identified significant results in this report.

N77-27468*# Milan Univ. (Italy).
GEOMORPHIC AND LANDFORM SURVEY OF NORTHERN APPENNINE RANGE (NAR) Final Report
C. M. Marino, Principal Investigator and E. Zilioli Jun. 1977 30 p Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(E77-10178; NASA-CR-153276) Avail: NTIS HC A03/MF A01 CSCL 08G

The author has identified the following significant results. An approach to landslide hazard detection was developed through the analysis of satellite imagery (LANDSAT 2) showing many landslide areas that occur on marine silts and clays in northern Appennine Range in Italy. A landslide risk score was given for large areas by narrowing and extending well defined areas, whose behavior and reflectivity variation was due to upper surface changes. Results show that this methodology allows evolution pattern of clay outflows to be distinguished.

N77-27469*# Environmental Research Inst. of Michigan, Ann Arbor.
THE USE OF UNSUPERVISED CLUSTERING AS A CLASSIFIER FOR LACIE MSS DATA
Alex P. Pentland, Principal Investigator Oct. 1975 12 p refs EREP
(Contract NAS9-14123)
(E77-10179; NASA-CR-151329; ERIM-109600-39-R) Avail: NTIS HC A02/MF A01 CSCL 05B

The author has identified the following significant results. This classification method appears to give accurate field center results and to give practical, statistically consistent and accurate estimates of crop proportions. The accuracy of this method is attributable to certain qualities of the particular clustering algorithm. These qualities are freedom from assumptions about Gaussian data, and the continual updating of distribution estimates, including updating the number of modes. This method is relatively tolerant of errors in the determination of crop type, as crop identity is used only for identifying clusters, and not for computing signatures.

N77-27470*# Kansas Univ. Center for Research, Inc., Lawrence.
THE APPLICATION OF REMOTE SENSING TO RESOURCE MANAGEMENT AND ENVIRONMENTAL QUALITY PROGRAMS IN KANSAS Annual Report, 1 Apr. 1976 - 31 Mar. 1977
B. G. Barr, Principal Investigator and E. A. Martinko Apr. 1977 83 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(Grant NGL-17-004-024)
(E77-10180; NASA-CR-153277) Avail: NTIS HC A05/MF A01 CSCL 05A

There are no author-identified significant results in this report.

N77-27471*# General Electric Co., Philadelphia, Pa. Space Systems Organization.
LANDSAT D OPERATIONS CONTROL CENTER STUDY
L. Alexander, G. Brown, B. Clemson, J. Efner, N. Engelberg, J. Owen, and T. Winchester 2 May 1977 97 p
(Contract NAS5-23412)
(NASA-CR-152543; Doc-77SDS4232) Avail: NTIS

HC A05/MF A01 CSCL 05B

Various aspects of the planned LANDSAT D system are discussed. LANDSAT D incorporates the Thematic Mapper (TM) as a sensor, it utilizes the Multi-mission Modular Spacecraft (MMS), it makes use of the Tracking and Data Relay Satellite System (TDRSS) and it employs a more advanced ground system. Each of these represent significant improvements in the state-of-the-art. Author

N77-27472*# Lockheed Electronics Co., Houston, Tex. Systems and Services Div.

GEMINI PHOTOGRAPHS OF THE WORLD: A COMPLETE INDEX

L. E. Giddings May 1977 106 p

(Contract NAS9-15200)

(NASA-CR-151445; LEC-10508) Avail: NTIS HC A06/MF A01 CSCL 05B

The most authoritative catalogs of photographs of all Gemini missions are assembled. Included for all photographs are JSC (Johnson Space Center) identification number, percent cloud cover, geographical area in sight, and miscellaneous information. In addition, details are given on cameras, filters, films, and other technical details. Author

N77-27473*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LANDSAT 2 CUMULATIVE NON-US STANDARD CATALOG Annual Cumulative Report, 22 Jan. 1976 - 22 Jan. 1977

22 Feb. 1977 1424 p

(NASA-TM-74758; GSFC/LN-C/013; NTISUB/C/139-013) Avail: NTIS HC A99/MF A01 CSCL 05B

The Non-U.S. Standard Catalog lists imagery acquired by LANDSAT 1 and LANDSAT 2 which has been processed and input to the data files during the referred month. Data, such as data acquired, cloud cover and image quality are given for each scene. The microfilm roll and frame on which the scene may be found is also given. Author

N77-27474*# Kanner (Leo) Associates, Redwood City, Calif.

LANDSAT (ERTS) USED AS A BASIS FOR GEOLOGICAL VOLCANOLOGICAL MAPPING IN THE CENTRAL ANDES

S. Kussmaul and C. E. Brockman Washington NASA Jul. 1977 19 p refs Transl. into ENGLISH from Geol. Jahrb. (Hanover, W. Germany), v. A33, 1976 p 133-144

(Contract NASw-2790)

(NASA-TM-75024) Avail: NTIS HC A02/MF A01 CSCL 08G

LANDSAT images of the central Andes (N-Chile, W-Bolivia) were effectively used for volcanological mapping of an area about 160,000 km. The map shown exhibits more and better details than the older small scale geological maps of that area. Even on a scale of 1:1,000,000 details greater than 200 m in size are recognizable. The interpretation of LANDSAT images makes it possible to establish relative age sequences of strato-volcanoes. Finally, the images will also be helpful in prospecting for mineral deposits and geothermal sources. Author

N77-27475*# Transemantics, Inc., Washington, D.C.

THE ROLE OF SATELLITE OBSERVATIONS IN THE MANAGEMENT OF ENVIRONMENTAL RESOURCES, WITH PARTICULAR REGARD TO THE AGRESITE PROJECT

Gianna Calabresi NASA Jul. 1977 10 p Transl. into ENGLISH of Report, no. B/11156, Dept. of Political Sci., Rome Univ., 1975 - 1976 p 143-156

(Contract NASw-2792)

(NASA-TM-X-75028) Avail: NTIS HC A02/MF A01 CSCL 05A

Potential applications of LANDSAT remote sensing technology to worldwide resources management are discussed. Some concern is expressed regarding a potential threat to individual national security. D.M.L.

N77-27476*# Texas A&M Univ., College Station. Remote Sensing Center.

[APPLICATIONS OF REMOTE SENSING SURVEYS IN TEXAS] Progress Report, 1 Feb. 1976 - 31 Jan. 1977

31 Jan. 1977 64 p refs

(Grant NGL-44-001-001)

(NASA-CR-153295; RSC-10) Avail: NTIS HC A04/MF A01 CSCL 05B

The grant project continues to introduce remote sensing technology to users in Texas and other regions in the South through presentation of papers and briefings at technical and professional meetings. Author

N77-27477*# Transemantics, Inc., Washington, D.C.

EXPERIMENTAL PROGRAM FOR THE OPERATIONAL STUDY OF DATA COLLECTION PLATFORMS IN BOLIVIA

Washington NASA Jun. 1977 13 p Transl. into ENGLISH from Serv. Geol. Bolivia, (La Paz), Dec. 1975 p 1-10z

(Contract NASw-2792)

(NASA-TM-75019) Avail: NTIS HC A02/MF A01 CSCL 05B

The system developed for the SMS/GOES satellite while learning the limitations possessed by this system with regard to the LANDSAT 1 and 2 satellites with respect to the transmission distance and horizon angle is investigated. The advantages possessed by this system in comparison with conventional methods are evaluated so as to permit studying the feasibility of introducing it into this country in the near future. Author

N77-27478*# Scientific Translation Service, Santa Barbara, Calif.

RESTEC (REMOTE SENSING TECHNOLOGY CENTER), VOLUME 1, NO. 1, 1976

Washington NASA May 1977 133 p refs Transl. into ENGLISH from RESTEC (Remote Sensing Technology Center) (Japan), v. 1, no. 1, 1976 p 1-75

(Contract NASw-2791)

(NASA-TT-F-17532) Avail: NTIS HC A07/MF A01 CSCL 05B

Articles are presented on the use of LANDSAT photographs in geology, remote sensing in agriculture, remote sensing of the seas, the history of remote sensing, and other subjects. Author

N77-27479*# National Aeronautics and Space Administration. Earth Resources Lab., Slidell, La.

DIGITAL OVERLAYING OF THE UNIVERSAL TRANSVERSE MERCATOR GRID WITH LANDSAT-DATA DERIVED PRODUCTS

Thomas W. Pendleton Jun. 1976 45 p refs

(NASA-TM-74761; Rept-160) Avail: NTIS HC A03/MF A01 CSCL 08B

Software has been written in FORTRAN IV for a Varian 73 computer which reformats LANDSAT-data-derived surface classifications and pictorial representations into a digital array which corresponds to the Universal Transverse Mercator Grid. Author

N77-27480*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

RESULTS OF LARGE AREA CROP INVENTORY EXPERIMENT (LACIE) DROUGHT ANALYSIS (SOUTH DAKOTA DROUGHT 1976)

David R. Thompson Sep. 1976 39 p Original contains color illustrations

(NASA-TM-74760; LACIE-00437; JSC-11666) Avail: NTIS HC A03/MF A01 CSCL 08H

LACIE using techniques developed from the southern Great Plains drought analysis indicated the potential for drought damage in South Dakota. This potential was monitored and as it became apparent that a drought was developing, LACIE implemented some of the procedures used in the southern Great Plains drought. The technical approach used in South Dakota involved the normal use of LACIE sample segments (5 x 6 nm) every 18 days. Full frame color transparencies (100 x 100 nm) were used on 9 day intervals to identify the drought area and to track overtime. The green index number (GIN) developed using the Kauth transformation was computed for all South Dakota segments and selected North Dakota segments. A scheme for classifying segments as drought affected or not affected was devised and tested on all available 1976 South Dakota data. Yield model simulations were run for all CRD's Crop Reporting District) in South Dakota. Author

N77-27481*# ECON, Inc., Princeton, N.J.

A DISTRIBUTION BENEFITS MODEL FOR IMPROVED INFORMATION ON WORLDWIDE CROP PRODUCTION. VOLUME 1: MODEL STRUCTURE AND APPLICATION TO WHEAT

John Andrews 30 Jun. 1976 99 p refs
(Contract NASw-2558)
(NASA-CR-153903; Rept-76-104-1A) Avail: NTIS HC A05/MF A01 CSCL 02B

The improved model is suitable for the study of benefits of worldwide information on a variety of crops. Application to the previously studied case of worldwide wheat production shows that about $108 million per year of distribution benefits to the United States would be achieved by a satellite-based wheat information system meeting the goals of LACIE. The model also indicates that improved information alone will not change world stock levels unless production itself is stabilized. The United States benefits mentioned above are associated with the reduction of price fluctuations within the year and the more effective use of international trade to balance supply and demand. Price fluctuations from year to year would be reduced only if production variability were itself reduced. Author

N77-27482*# ECON, Inc., Princeton, N.J.
A DISTRIBUTION BENEFITS MODEL FOR IMPROVED INFORMATION ON WORLDWIDE CROP PRODUCTION. VOLUME 2: APPLICATION TO VARIOUS CROPS Final Report
John Andrews 30 Jun. 1976 126 p refs
(Contract NASw-2558)
(NASA-CR-153902; Rept-76-104-1B) Avail: NTIS HC A07/MF A01 CSCL 02B

ECON's distribution benefits model has been applied to worldwide distribution of corn, rye, oats, barley, soybeans, and sugar, and to domestic distribution of potatoes. The results indicate that a LANDSAT system with thematic mapper might produce benefits to the United States of about $119 million per year, due to more efficient distribution of these commodities. The benefits to the rest of the world have also been calculated, with a breakdown between trade benefits and those associated with internal use patterns. By far the greatest part of the estimated benefits are assigned to corn, with smaller benefits assigned to soybeans and the small grains (rye, oats, and barley). Author

N77-27483*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MULTISPECTRAL REMOTE OBSERVATIONS OF HYDROLOGIC FEATURES ON THE NORTH SLOPE OF ALASKA
Dorothy K. Hall and M. Leonard Bryan (JPL, Pasadena, Calif.) May 1977 46 p refs Submitted for publication
(NASA-TM-X-71351; X-913-77-124) Avail: NTIS HC A03/MF A01 CSCL 08H

Visible and near-infrared satellite data and active and passive microwave aircraft data are used to analyze some hydrologic features in Arctic Alaska. The following features have been studied: the small thaw lakes on the Arctic Coastal Plain (oriented lakes), Chandalar Lake in the Brooks Range, several North Slope rivers, surface water on the tundra, and snowcover on the North Slope and in the Brooks Range. Passive microwave brightness temperatures (T sub b) as seen on Electrically Scanned Microwave Radiometer (ESMR) imagery are shown to increase with increasing ice thickness on all of the lakes studied. Aufeis, an important hydrologic parameter in the Arctic, is observable in the Sagavanirktok River channel on April ESMR imagery. LANDSAT imagery with better (80 m) resolution is useful for measuring aufeis extent using band 5 imagery obtained just after snowmelt in June. It is shown that the extent of aufeis (as measured on LANDSAT imagery) varies with meteorological conditions and, therefore, may be a useful indicator of annual climate fluctuations on the North Slope. Snow and ice breakup has been traced from the Brooks Range Mountains to the Arctic Ocean Coast using LANDSAT band 7 imagery in May when melting begins in the mountains. Author

N77-27484*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMOTE SENSING OF THE ATMOSPHERE FROM ENVIRONMENTAL SATELLITES
Lewis J. Allison, Raymond Wexler, Charles R. Laughlin, and William R. Bandeen Jun. 1977 124 p refs Submitted for publication
(NASA-TM-X-71353; X-901-77-132) Avail: NTIS HC A06/MF A01 CSCL 04A

Various applications of satellite remote sensing of the earth are reviewed, including (1) the use of meteorological satellites to obtain photographic and radiometric data for determining weather conditions; (2) determination of the earth radiation budget from measurements of reflected solar radiation and emitted long wave terrestrial radiation; (3) the use of microwave imagery for measuring ice and snow cover; (4) LANDSAT visual and near infrared observation of floods and crop growth; and (5) the use of the Nimbus 4 backscatter ultraviolet instrument to measure total ozone and vertical ozone distribution. Plans for future activities are also discussed. D.M.L.

N77-27485*# Environmental Research Inst. of Michigan, Ann Arbor.
ACTIVE AND PASSIVE MULTISPECTRAL SCANNER FOR EARTH RESOURCES APPLICATIONS: AN ADVANCED APPLICATIONS FLIGHT EXPERIMENT Final Report, 12 Jun. 1975 - 20 Apr. 1977
P. G. Hasell, Jr., L. M. Peterson, F. J. Thomson, E. A. Work, and F. J. Kriegler Jun. 1977 98 p refs
(Contract NAS9-14594)
(NASA-CR-151461; ERIM-115800-49-F) Avail: NTIS HC A05/MF A01 CSCL 20F

The development of an experimental airborne multispectral scanner to provide both active (laser illuminated) and passive (solar illuminated) data from a commonly registered surface scene is discussed. The system was constructed according to specifications derived in an initial programs design study. The system was installed in an aircraft and test flown to produce illustrative active and passive multi-spectral imagery. However, data was not collected nor analyzed for any specific application. Author

N77-27486*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT 2 CUMULATIVE US STANDARD CATALOG Annual Cumulative, 22 Jan. 1976 - 22 Jan. 1977
22 Feb. 1977 878 p
(NASA-TM-74757; GSFC/LU-C/013; NTISUB/C/138-013)
Avail: NTIS HC A99/MF A01 CSCL 05B

The U.S. Standard Catalog lists U.S. imagery acquired by LANDSAT 1 and LANDSAT 2 which has been processed and input to the data files during the referenced month. Data, such as date acquired, cloud cover and image quality, are given for each scene. The microfilm roll and frame on which the scene may be found is also given. Author

N77-27487# DBA Systems, Inc., Melbourne, Fla.
STUDIES IN ADVANCED PHOTOGRAMMETRIC TRIANGULATION TECHNIQUES Final Technical Report, Mar. - Oct. 1976
T. Riding and S. Mundy Mar. 1977 145 p refs
(Contract F30602-76-C-0172)
(AD-A038138; RADC-TR-77-72) Avail: NTIS HC A07/MF A01 CSCL 14/5

Analytical photogrammetry, spurred on by a rapidly evolving computer technology has achieved major advances within the past decade. Contained in this report is an attempt to define those near term challenges brought about by larger data sets, such developments as the Global Positioning System, and continued improvement in auxiliary sensors (e.g., inertial platforms, stratoscope units, etc.). Continued research commensurate with these challenges are of paramount importance where a first order, wide area mapping requirement exists. GRA

N77-27488# Hawaii Univ., Honolulu. Water Resources Research Center.
SIMPLIFIED TECHNIQUES FOR DETERMINING WATER CONDUCTING AND WATER STORAGE PROPERTIES OF SOILS Completion Report, 1 Jul. 1975 - 30 Jun. 1976
Lajpat R. Ahuja and Richard E. Green Oct. 1976 40 p refs
(Contract DI-14-34-0001-6012)
(PB-265171/9; TMR-51; W77-05853; OWRT-A-060-HI (1))
Avail: NTIS HC A03/MF A01 CSCL 08M

Four simplified methods of simultaneously determining both hydraulic conductivity and water characteristic functions of a soil from field tensiometric data for drainage were investigated. These soil-water properties were assumed to be described by certain simple power or logarithmic functional forms. Two of

the function parameters were the near-saturated values of soil-water content and hydraulic conductivity, which were assumed to be known (from measurements during infiltration preceding the drainage). The other two unknown parameters were determined either by the least-squares optimization over the complete range of data, or by the algebraic manipulation of data for two consecutive time values. GKA

N77-27489# Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.
COMPUTER SIMULATION OF SNOWMELT
Rhev M. Solomon (Gila National Forest), Peter F. Ffolliott (Arizona Univ., Tucson), Malchus B. Baker, Jr., and J. R. Thompson Oct. 1976 14 p refs
(Contract DI-14-31-0001-3803)
(PB-265109/9; FSRP-RM-174; W77-05735; OWRT-A-042-ARIZ(13)) Avail: NTIS HC A02/MF A01 CSCL 08L

A previously developed computer model of snowmelt was modified to model intermittent snowpacks. The modified program SNOWMELT is dependent on four daily input variables-maximum and minimum temperatures, precipitation, and shortwave radiation or percent cloud cover. Initializing the model requires limited knowledge of local watershed and snowpack parameters. Model verification and seven experimental watersheds in Arizona proved satisfactory. GRA

N77-27490# National Committee for the International Hydrological Decade, Washington, D. C. Work Group on Snow and Ice Hydrology.
SNOW AND ICE HYDROLOGY IN THE UNITED STATES: CURRENT STATUS AND FUTURE DIRECTIONS Final Report
1976 75 p refs
(Grant NSF G-310)
(PB-264466/4) Avail: NTIS HC A04/MF A01 CSCL 08L

Specific research needs in snow and ice hydrology are identified, and recommended: (1) lead-agency responsibility for data collection and dissemination, (2) development of a national data system, (3) an increase in funding for research; and (4) direction of research toward the synthesis of results from many geographic areas and toward studies of the primary chemical and physical processes affecting snow and ice. GRA

N77-27491# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Renewable Resources for Industrial Materials.
REFERENCE MATERIALS SYSTEM: A SOURCE FOR RENEWABLE MATERIALS ASSESSMENT
James S. Bethel 1976 86 p refs
(Grant NSF STP-75-01069)
(PB-264494/6; NSF/PRA-7501069/2/7) Avail: NTIS HC A05/MF A01 CSCL 02F

The role of renewable resources in helping to better meet needs for materials in the future was examined. Important factors to be taken into account in assessing the desirable balance between these different classes of resources for materials are the increasing variety of technological options available for choice of material for a required performance in a given application, and the increasing concern to minimize both consumption of energy and environmental impact. Strong specialization exists in forest sciences and wood products on the one hand, and agricultural sciences and associated natural materials (such as fibers and leathers) on the other. GRA

N77-27492# Nevada Univ., Las Vegas. Water Resources Center.
CONSIDERATION OF TOTAL ENERGY LOSS IN THEORY OF FLOW TO WELLS
R. L. Cooley and A. B. Cunningham Mar. 1977 55 p refs
(Contract DI-14-31-0001-5028)
(PB-264717/0; H-W-Pub-30; W77-05368; OWRT-A-061-NEV(1)) Avail: NTIS HC A04/MF A01 CSCL 08H

A coupled numerical solution for unsteady flow in single or multiple aquifiers and the well penetrating the system was developed. Analysis of hypothetical problems indicates that, because of friction losses and nonuniform flow in the well bore, a significant region of nonradial flow in the aquifer(s) results whenever aquifer hydraulic conductivity is greater than about 0.015 m/min and pumping rate is greater than about 1.2 cubic meters min. Because of this nonradial flow, significant errors in computed aquifer transmissivity can occur whenever aquifer hydraulic conductivity is greater than about 0.03 m/min. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N77-27493*# Raines (Jeremy K.), Bethesda, Md.
THEORETICAL ANALYSIS OF THE EWEC REPORT
30 Dec. 1976 100 p refs
(Contract NAS5-23641)
(NASA-CR-152542) Avail: NTIS HC A05/MF A01 CSCL 10A

This analytic investigation shows how the electromagnetic wave energy conversion (EWEC) device, as used for solar-to-electric power conversion, is significantly different from solar cells, with respect to principles of operation. An optimistic estimate of efficiency is about 80% for a full-wave rectifying configuration with solar radiation normally incident. This compares favorably with the theoretical maximum for a CdTe solar cell (23.5%), as well as with the efficiencies of more familiar cells: Si (19.5%), InP (21.5%), and GaAs (23%). Some key technological issues that must be resolved before the EWEC device can be realized are identified. Those issues include: the fabrication of a pn semi-conductor junction with no permittivity resonances in the optical band; and the efficient channeling of the power received by countless microscopic horn antennas through a relatively few number of wires. Author

N77-27494*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POTENTIAL BENEFITS OF A CERAMIC THERMAL BARRIER COATING ON LARGE POWER GENERATION GAS TURBINE
John S. Clark and Joseph J. Nainiger Jun. 1977 57 p refs
(Contract E(49-28)-1028)
(NASA-TM-73712; E-9251; ERDA/NASA-5022/77/1) Avail: NTIS HC A04/MF A01 CSCL 10B

Thermal barrier coating design option offers benefit in terms of reduced electricity costs when used in utility gas turbines. Options considered include: increased firing temperature, increased component life, reduced cooling air requirements, and increased corrosion resistance (resulting in increased tolerance for dirty fuels). Performance and cost data were obtained. Simple, recuperated and combined cycle applications were considered, and distillate and residual fuels were assumed. The results indicate that thermal barrier coatings could produce large electricity cost savings if these coatings permit turbine operation with residual fuels at distillate-rated firing temperatures. The results also show that increased turbine inlet temperature can result in substantial savings in fuel and capital costs. Author

N77-27495*# Westinghouse Electric Corp., Lester, Pa. Generation Systems Div.
ANALYTICAL INVESTIGATION OF THERMAL BARRIER COATINGS ON ADVANCED POWER GENERATION GAS TURBINES
D. J. Amos Mar. 1977 110 p refs
(Contract NAS3-19407)
(NASA-CR-135146; EM-1636) Avail: NTIS HC A06/MF A01 CSCL 10B

An analytical investigation of present and advanced gas turbine power generation cycles incorporating thermal barrier turbine

component coatings was performed. Approximately 50 parametric points considering simple, recuperated, and combined cycles (including gasification) with gas turbine inlet temperatures from current levels through 1644K (2500 F) were evaluated. The results indicated that thermal barriers would be an attractive means to improve performance and reduce cost of electricity for these cycles. A recommended thermal barrier development program has been defined. Author

N77-27496*# United Technologies Corp., South Windsor, Conn. Power Systems Div.
THERMAL BARRIER COATING ON HIGH TEMPERATURE INDUSTRIAL GAS TURBINE ENGINES Final Report
Nils Carlson and Barry L. Stoner (Pratt and Whitney Aircraft, East Harford, Conn.) Feb. 1977 60 p
(Contracts NAS3-20067; e(49-28)-1022)
(NASA-CR-135147; ERDA/NASA-0067/77/1; PSD-R-109) Avail: NTIS HC A04/MF A01 CSCL 10B

The thermal barrier coating used was a yttria stabilized zirconia material with a NiCrAlY undercoat, and the base engine used to establish improvements was the P&WA FT50A-4 industrial gas turbine engine. The design benefits of thermal barrier coatings include simplified cooling schemes and the use of conventional alloys in the engine hot section. Cooling flow reductions and improved heating rates achieved with thermal barrier coating result in improved performance. Economic benefits include reduced power production costs and reduced fuel consumption. Over the 30,000 hour life of the thermal barrier coated parts, fuel savings equivalent to $5 million are projected and specific power (megawatts/mass of engine airflow) improvements on the order of 13% are estimated. Author

N77-27497*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOTOVOLTAIC-POWERED REFRIGERATOR EXPERIMENT AT ISLE ROYALE NATIONAL PARK
A. F. Ratajczak Jun. 1977 32 p
(Contract E(49-26)-1022)
(NASA-TM-73703; E-9241; ERDA/NASA-1022/77/15) Avail: NTIS HC A03/MF A01 CSCL 10A

The use of a photovoltaic power system to operate an electric refrigerator at a trail construction camp at Isle Royale, Michigan is investigated. The use of P/V power for refrigeration in a remote installation is demonstrated. System design as well as predicted and measured system performance are presented. Author

N77-27498*# Scientific Translation Service, Santa Barbara, Calif.
SOLUBILIZATION OF COAL IN ORGANIC MEDIA
Ph. Lahaye and D. Decroocq Washington NASA Jul. 1977 44 p refs Transl. into ENGLISH from Rev. Inst. Fr. Petrole Ann. Combust. Liquides (Paris), v. 31, no. 1, Jan. - Feb. 1976 p 99-130 Original language document was announced as A76-46522
(Contract NAS7-100)
(NASA-TM-75151) Avail: NTIS HC A03/MF A01 CSCL 10B

The use of solvent extraction to solubilize coal is discussed. Simple extractions are described which are conducted at moderate temperatures to exclude extraneous chemical reactions which would lead to uncontrolled changes in the components of the treated coal. Sample preparation, extraction apparatus, and the determination of extract yield for different experiments are also described. D.M.L.

N77-27499# Committee on the Judiciary (U. S. House).
ENERGY INDUSTRY INVESTIGATION. PART 1: JOINT VENTURES
Washington GPO 1976 621 p refs Hearings before Subcomm. on Monopolies and Commercial Law of the Comm. on the Judiciary, 94th Congr., 1st and 2d Sess., 30 Jul., 4 Sep. 1975 (GPO-72-530) Avail: Subcomm. on Monopolies and Commercial Law

The Subcommittee on Monopolies hearing on recent gasoline price increases and antitrust commercial laws are presented.I.M.

N77-27500# Committee on the Judiciary (U. S. House).
ENERGY INDUSTRY INVESTIGATION. PART 2: INDUSTRY STRUCTURE
Washington GPO 1977 638 p refs Hearings before Subcomm. on Monopolies and Commercial Law of the Comm. on the Judiciary, 94th Congr., 1st Sess., 31 Jul., 10-11 Sep. 1975 (GPO-83-695) Avail: Subcomm. on Monopolies and Commercial Law

For Abstract, see N77-27499.

N77-27501*# Boeing Co., Seattle, Wash.
NICKEL CADMIUM CELL DESIGNS NEGATIVE TO POSITIVE MATERIAL RATIO AND PRECHARGE LEVELS
Sidney Gross Jun. 1977 44 p refs Prepared for JPL
(Contracts NAS7-100; JPL-953984)
(NASA-CR-153904) Avail: NTIS HC A03/MF A01 CSCL 10A

A review is made of the factors affecting the choices of negative-to-positive materials ratio and negative precharge in nickel-cadmium cells. The effects of these variables on performance are given, and the different methods for setting precharge are evaluated. The effects of special operating requirements on the design are also discussed. Author

N77-27502*# Solarex Corp., Rockville, Md.
DEVELOPMENT OF A HIGH EFFICIENCY THIN SILICON SOLAR CELL
Joseph Lindmayer Aug. 1977 16 p Prepared for JPL
(Contracts NAS7-100; JPL-954290)
(NASA-CR-153905; QR-7; SX/105/7Q) Avail: NTIS HC A02/MF A01 CSCL 10A

Preparation for full scale operation of the pilot line included reduction of the back metallization coverage to reduce the differential thermal expansion of very thin cells, mapping excess injection current at low dark forward voltage, determining the radius of curvature for fracture as a function of silicon thickness, and determining absorptance/emittance ratios for thin silicon solar cells. Author

N77-27503*# Battelle Columbus Labs., Ohio.
METHODOLOGY FOR DESIGNING ACCELERATED AGING TESTS FOR PREDICTING LIFE OF PHOTOVOLTAIC ARRAYS Final Report
G. B. Gaines, R. E. Thomas, G. C. Derringer, C. W. Kistler, D. M. Bigg, and D. C. Carmichael 1 Feb. 1977 141 p refs Prepared for JPL Sponsored in part by ERDA
(Contracts NAS7-100; JPL-954328)
(NASA-CR-153906; ERDA/JPL-954328-77/1) Avail: NTIS HC A07/MF A01 CSCL 10A

A methodology for designing aging tests in which life prediction was paramount was developed. The methodology builds upon experience with regard to aging behavior in those material classes which are expected to be utilized as encapsulant elements, viz., glasses and polymers, and upon experience with the design of aging tests. The experiences were reviewed, and results are discussed in detail. Author

N77-27504*# Motorola, Inc., Phoenix, Ariz. Semiconductor Group.
LASER-ZONE GROWTH IN A RIBBON-TO-RIBBON (RTR) PROCESS SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SILICON SHEET TASK OF THE LOW COST SILICON SOLAR ARRAY PROJECT Quarterly Report
R. W. Gurtler, A. Baghdadi, J. Wise, and R. J. Ellis Jun. 1977 100 p Prepared for JPL Sponsored in part by ERDA
(Contract NAS7-100; JPL-954376)
(NASA-CR-153908; Rept-2256/6; QR-5; ERDA/JPL-954376-77/3) Avail: NTIS HC A05/MF A01 CSCL 10A

The Ribbon-to-Ribbon (RTR) approach to silicon ribbon growth was investigated. An existing RTR apparatus, RTR#1, was upgraded to allow for 5 cm wide ribbon growth with a finite stroke length of at least 15 cm. A second RTR apparatus, RTR#2, was designed, built, and operated which utilizes continuous feed mechanisms and allows continuous growth of 7.5 cm wide ribbons. RTR#2 includes development and utilization of advanced beam scanning (or shaping), high power lasers, and thermal profile modification elements to attain maximum growth velocities (with a design goal of 18 cm/min). Materials studies, process development, and thermal analyses are also described. Residual

stresses and dislocation densities were minimized through theoretical and experimental efforts towards optimization of thermal profiles. Growth runs were performed on RTR#2 and solar cells were fabricated which demonstrated efficiencies greater than 10%. Author

N77-27505*# Texas Instruments, Inc., Dallas.
AUTOMATED ARRAY ASSEMBLY TASK, PHASE 1 Annual Report
Bernard G. Carbajal Mar. 1977 111 p refs Prepared for JPL Sponsored in part by ERDA
(Contracts NAS7-100; JPL-954405)
(NASA-CR-153909; TI-03-77-17; ERDA/JPL-954405-77/4) Avail: NTIS HC A06/MF A01 CSCL 10A

An assessment of state-of-the-art technologies that are applicable to silicon solar cell and solar cell module fabrication is provided. The assessment consists of a technical feasibility evaluation and a cost projection for high-volume production of silicon solar cell modules. The cost projection was approached from two directions; a design-to-cost analysis assigned cost goals to each major process element in the fabrication scheme, and a cost analysis built up projected costs for alternate technologies for each process element. A technical evaluation was used in combination with the cost analysis to identify a baseline low cost process. A novel approach to metal pattern design based on minimum power loss was developed. These design equations were used as a tool in the evaluation of metallization technologies. Author

N77-27506# Virginia Univ., Charlottesville. Dept. of Mechanical Engineering.
ENGINEERING ANALYSIS AND TESTING OF WATER-TRICKLE SOLAR COLLECTOR Annual Progress Report, Jun. 1975 - May 1976
J. Taylor Beard Jun. 1976 35 p refs
(Contract E(40-1)-4927)
(ORO-4927-76-2; Rept-2) Avail: NTIS HC A03/MF A01

An outdoor solar collector facility has been developed at the University of Virginia for the purpose of conducting a thermal performance evaluation of the Thomason SOLARIS water-trickle solar collector panels. A near linear relationship of efficiency is displayed as a function of the difference between inlet water temperature and the ambient temperature, divided by the incident solar energy. The significant scatter in the data results from other variables which are analyzed and include glazing cleanliness, angle of incidence, water evaporation and condensation, wind condition, and the influence of condensate droplets on the overall solar energy transmitted to the absorbing surface. The performance of the SOLARIS water-trickle collector is compared with published results for conventional single and double flat-plate collectors. ERA

N77-27507# Energy Research and Development Administration, Washington, D.C.
ENERGY SOURCES FOR TOMORROW
M. Meliss 1976 17 p Transl. into ENGLISH from West German Report, 1976 17 p
(ERDA-tr-226) Avail: NTIS A02/MF A01

The regenerative sources of solar energy, wind, energy from the seas, earth heat, and running water were investigated by a consortium of major research installations. The sources were assessed first on a global basis, then more specifically for the German Federal Republic. This paper summarizes results from the complete study, but devoted mostly to an analysis of utilization of wind energy, using the following topics: physical bases and theoretical potential, wind energy installations and technically useful potential, utility aspects, and recommendations for research and development work. ERA

N77-27508# United Technologies Corp., South Windsor, Conn. Power Systems Div.
ADVANCED TECHNOLOGY FUEL CELL PROGRAM Final Report
Joseph M. King, Jr. Oct. 1976 107 p refs Sponsored by EPRI
(EPRI-EM-335) Avail: NTIS HC A06/MF A01

Hydrodesulfurization of naphtha was adapted to fuel cell conditions; catalyst endurance and ability to use naphthas from a range of U.S. refineries were demonstrated. A 520-hour test demonstrated the technical feasibility of operating on No. 2 fuel oil. A study of centralstation coal powerplants showed integrated powerplants consisting of a gasifier, fuel cell, and bottoming cycle, provide estimated overall efficiencies of 40 percent for plants based on the phosphoric-acid cell and of 50 percent or higher for powerplants based on the molten-carbonate cell. ERA

N77-27509# Illinois Univ., Urbana. Center for Advanced Computation.
ENERGY USE FOR BUILDING CONSTRUCTION Progress Report, 1 Mar. - 1 Aug. 1976
B. M. Hannon, R. G. Stein, B. Segal, D. Serber, and C. Stein Aug. 1976 83 p refs
(Contract E(11-1)-2791)
(COO-2791-2) Avail: NTIS HC A05/MF A01

Total (direct and indirect) energy requirements of the construction industry were determined in order to examine the potential for energy savings. The Energy Input/Output Model developed was expanded to include a detailed breakdown of the industry and energy intensities of 49 building construction (new and maintenance) sectors and of the overall building construction industry were determined. ERA

N77-27510# General Electric Co., Schenectady, N.Y. Electrochemistry Branch.
DEVELOPMENT OF SODIUM-SULFUR BATTERIES FOR UTILITY APPLICATION Annual Report
D. Chatterji Dec. 1976 248 p refs Sponsored by EPRI
(EPRI-EM-266) Avail: NTIS HC A11/MF A01

The development of a sodium-sulfur battery system for bulk storage of energy is described. Two initial cell/module/system designs are discussed. The cell in these preliminary designs consists of many individual beta-alumina tubes used as the separator between single sodium and sulfur compartments. Heat conduction experiments were made and a complete thermal analysis of the system is given. A statistical analysis of the effects of failure or change in performance of individual cells or modules and a study on optimization of the system cost were performed. ERA

N77-27511# Brookhaven National Lab., Upton, N. Y.
ENERGY MANAGEMENT IN RESIDENTIAL AND SMALL COMMERCIAL BUILDINGS Annual Report
John Batey, V. Gazerro, F. J. Salzano, and A. L. Berlad Jul. 1976 54 p refs
(Contract EY-76-C-02-0016)
(BNL-50576) Avail: NTIS HC A04/MF A01

Efficiency measurements performed on conventional residential oil-fired hot water heating equipment, including both steady state and cyclic (part load) efficiency determinations are described. A list of preliminary recommendations for retrofit actions to improve efficiency is provided. A summary of work carried out in the areas of thermal storage media, fenestration, and building thermal dynamics is also presented. ERA

N77-27512# Argonne National Lab., Ill.
DESIGN AND TESTING OF LITHIUM/IRON SULFIDE BATTERIES FOR ELECTRIC VEHICLE PROPULSION
A. A. Chilenskas, G. J. Bernstein, J. E. A. Graae, F. Hornstra, M. A. Slawecki, V. Kolba, and R. O. Ivins 1976 33 p refs Presented at the 4th Intern. Elec. Vehicle Council, Dusseldorf, 30 Aug. - 2 Sep. 1976
(Contract W-31-109-eng-38)
(CONF-760866-2) Avail: NTIS HC A03/MF A01

A program to develop high-performance batteries for use in electric automobiles and for storing off-peak energy for load leveling in electric utility systems is described. The batteries for vehicle propulsion consist of cells with a central positive plate containing FeS2 and two facing negative plates containing Li-Al alloy. The electrolyte is the LiCl-KCl eutectic which has a melting point of 352 C and requires the cells to be operated at temperatures between 350 and 450 C. Prismatic cells 13 cm on a side and 2 to 4 cm thick were fabricated. Laboratory cells demonstrated a capacity at the 10-hour rate of about 120 Ah at 1.5V, which corresponds to a specific energy of about 150 W-hr/kg. A battery testing laboratory was established which contains equipment for charging and discharging the cells in a

mode that simulates the operation of the cells in an electric vehicle battery. ERA

N77-27513# Oak Ridge National Lab., Tenn.
SURVEY OF TECHNOLOGY FOR STORAGE OF THERMAL ENERGY IN HEAT TRANSFER SALT
M. D. Silverman and J. R. Engel 18 Jan. 1977 26 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5682) Avail: NTIS HC A03/MF A01

Several specific energy storage applications, such as intermediate-load and peaking electric power, solar energy, and energy from fluidized-bed coal burners, are discussed. Long-term stability and corrosion data on these salts are presently available only to approximately 480 C. However, for the design and construction of energy storage facilities to operate over many years at temperatures up to approximately 540 C, long-term tests of thermal stability and corrosion are needed. Means for obtaining such information are proposed. ERA

N77-27514# Los Alamos Scientific Lab., N. Mex.
DEVELOPMENT AND TESTS OF SUPERCONDUCTING MAGNETIC ENERGY STORAGE SYSTEMS COMPONENTS
H. J. Boenig, R. D. Turner, and W. V. Hassenzahl 1976 21 p refs Presented to the Frontiers of Power Technol. Conf., Stillwater, Okla., 27-28 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1978; Conf-760975-1) Avail: NTIS HC A02/MF A01

The electrical parameters of such a system are derived for constant power operation during magnet charging and discharging. A circuit to evaluate high current superconductors economically and nondestructively is described and test results for three different wires are presented. The design of an automated model SMES system which operates in a closed-loop power control mode is presented. Test results of a twelve-pulse converter loaded with a pure inductance are given. ERA

N77-27515# Los Alamos Scientific Lab., N. Mex.
ELECTROCHEMICAL HEAT ENGINES
Guy R. B. Elliott Dec. 1976 11 p
(Contract W-7405-eng-36)
(LA-6632-MS) Avail: NTIS HC A02/MF A01

Electrochemical cell reactions involving entropy change were investigated as the basis for heat engines. Sodium, potassium, and cesium look particularly promising as the working gases for higher-temperature cells (above 600 K), and halogen gases or volatile halides may be useful with lower-temperature heat sources. Carbonates and halides look promising as molten electrolytes and solid electrolytes may be useful as separators. ERA

N77-27516# Public Service Electric and Gas Co., Newark, N. J.
ECONOMIC ASSESSMENT OF THE UTILIZATION OF FUEL CELLS IN ELECTRIC UTILITY Final Report
William Wood, Murty P. Bhavaraju, and Paul Yatcko Nov. 1976 113 p Sponsored by EPRI
(EPRI-EM-336) Avail: NTIS HC A06/MF A01

The relationships between market penetration, fuel price, and capital cost for the two fuel cell types are discussed. In addition, the various penalties and savings that might occur to a utility through the installation of fuel cells are quantified. ERA

N77-27517# AiResearch Mfg. Co., Phoenix, Ariz.
PRELIMINARY RELIABILITY ALLOCATION AND ESTIMATION, BRAYTON ISOTOPE POWER SYSTEM
L. G. Miller 1 Jun. 1976 20 p
(Contract EY-76-C-03-1123)
(TID-27302; Rept-76-311851) Avail: NTIS HC A02/MF A01

The Brayton isotope power system is evaluated from the standpoint of its potential for long and reliable operation. Results are presented in tabular form. ERA

N77-27518# AiResearch Mfg. Co., Phoenix, Ariz.
PHASE 1: CONTROLS PRELIMINARY DESIGN REPORT FOR BRAYTON ISOTOPE POWER SYSTEM (BIPS)
20 Aug. 1976 312 p refs
(Contract EY-76-C-03-1123)
(TID-27263) Avail: NTIS HC A14/MF A01

Control systems capable of controlling the speed, output voltage, and start rate of Brayton isotope power system are evaluated. ERA

N77-27519# Energy Research and Development Administration, Grand Forks, N. Dak.
TECHNOLOGY AND USE OF LOW-RANK COALS IN THE USA
Gordon H. Gronhovd and Everett A. Sondreal 1976 43 p refs Presented at the Seminar on Technol. for the Util. of Low Calorie Fuels, Varna, Bulgaria, 20-22 Apr. 1976
(CONF-760495-1) Avail: NTIS HC A03/MF A01

The use of low-rank coals for power production and some of the related problems are discussed. Ash fouling of boiler tubes is the most serious operating problem. Research and commercial experience has shown fouling to be directly related to sodium and ash contents of the coals. Many of the US low-rank coals are relatively high in Na and require very conservative boiler designs. Boiler and fuel specifications are given for three recent plants of the 400 to 550 MW range designed to burn high-fouling lignites. ERA

N77-27520# Oak Ridge National Lab., Tenn.
COAL CONVERSION: DESCRIPTION OF TECHNOLOGIES AND NECESSARY BIOMEDICAL AND ENVIRONMENTAL RESEARCH
Aug. 1976 302 p refs
(Contract W-7405-eng-26)
(ORNL-5192) Avail: NTIS HC A14/MF A01

A description of the biomedical and environmental research necessary to ensure the timely attainment of coal conversion technologies amenable to man and his environment is presented. Topics are reviewed in sections. Section one studies; (1) types of processes currently being considered for development; (2) data currently available on composition of produce, (3) process and product streams, and their potential effects, (4) and problems that might arise from transportation and use of products. Section two is concerned with a description of the necessary research in each of the King-Muir categories, while the third section presents the research strategies necessary to assess the potential problems at the conversion plant (site specific) and those problems that might effect the general public and environment as a result of the operation of largescale coal conversion plants. ERA

N77-27521# Science Applications, Inc., McLean, Va.
SUPPLY OF LIQUEFIED NATURAL GAS TO THE NORTHEAST
G. R. Bray, S. K. Julin, and J. A. Simmons Apr. 1976 103 p refs
(Contract E(30-1)-16)
(BNL-50556) Avail: NTIS HC A06/MF A01

The following aspects of the supply of liquefied natural gas to the northeastern part of the U.S. are discussed: major facilities and equipment, institutional considerations and environmental impacts, site selection criteria, time required to implement an LNG (liquefied natural gas) project, projected availability and reliability of supply, projection of future imports to the northeast region, cost projections, and secondary benefits. ERA

N77-27522# AiResearch Mfg. Co., Phoenix, Ariz.
BRAYTON, ISOTOPE POWER SYSTEM (BIPS) DESIGN LAYOUT SUMMARY
15 Jun. 1976 75 p
(Contract EX-76-C-03-1123)
(TID-27262) Avail: NTIS HC A04/MF A01

A summary of the Brayton Isotope Power Systems (BIPS) design layout drawings is presented. These drawings were generated in compliance with Task 3 (preliminary Design of the BIPS Ground Demonstration System) of Phase I. ERA

N77-27523# AiResearch Mfg. Co., Phoenix, Ariz.
PROCUREMENT SPECIFICATION HIGH VACUUM TEST CHAMBER AND PUMPING SYSTEM
31 May 1976 62 p
(Contract EY-76-C-03-1123)
(TID-27257) Avail: NTIS HC A04/MF A01

Specific requirements for a high vacuum test chamber, associated vacuum pumps, valves, controls, and instrumentation that shall be designed and fabricated for use as a test chamber for testing a closed loop Brayton Isotope Power System (BIPS) Ground Demonstration System (GDS) were established. The vacuum system includes all instrumentation required for pressure measurement and control of the vacuum pumping system. A general outline of the BIPS-GDS in the vacuum chamber and the preliminary piping and instrumentation interface to the vacuum chamber are shown. ERA

N77-27524# Thermo Electron Corp., Waltham, Mass.
PRELIMINARY DESIGN REVIEW DOCUMENT APPLICATION OF MULTI-FOIL INSULATION TO THE BRAYTON ISOTOPE POWER SYSTEM AND CONCEPTUAL DESIGN OF MULTI-FOIL INSULATION FOR THE FLIGHT SYSTEM (PHASE 1)
11 Jun. 1976 83 p
(Contracts EY-76-C-03-1123)
(TE-4209-100-76) Avail: NTIS HC A05/MF A01

The status of the effort to apply multifoil thermal insulation in an effective manner to the Ground Development System (GDS) is reviewed. Heat loss measurements made on cylindrical and elbow heat sources using tape and conventional multifoil indicate that the thermal losses are comparable on a per layer basis. However, use of the tape incurs a weight penalty, per layer, of about 20 percent. Parametric studies of GDS insulaton losses indicate: (1) that the Heat Source Assembly (HSA) heat losses are a major fraction of the total and (2) that a significant reduction in heat loss is possible by optimizing the distribution of foil layers. A meltdown test of a miniature HSA configuration suggests that additional multifoil layers can be safely added to the HSA insulation. ERA

N77-27525# AiResearch Mfg. Co., Phoenix, Ariz.
SYSTEM SAFETY PROGRAM PLAN FOR THE ISOTOPE BRAYTON GROUND DEMONSTRATION SYSTEM (PHASE 1)
30 Sep. 1976 31 p
(Contract EY-76-C-03-1123)
(TID-27265) Avail: NTIS HC A03/MF A01

The safety engineering effort to be undertaken in achieving an acceptable level of safety in the Brayton Isotope Power System (BIPS) development program is discussed. The safety organizational relationships, the methods to be used, the tasks to be completed, and the documentation to be published are described. ERA

N77-27526# AiResearch Mfg. Co., Phoenix, Ariz.
PRELIMINARY FAILURE MODES, EFFECTS AND CRITICALITY ANALYSIS (FMECA) OF THE BRAYTON ISOTOPE POWER SYSTEM (BIPS) GROUND DEMONSTRATION SYSTEM
L. G. Miller 1 Jun. 1976 47 p refs
(Contract EY-76-C-03-1123)
(TID-27301; AiResearch-76-311965) Avail: NTIS HC A03/MF A01

A Failure Modes, Effects and Criticality Analysis (FMECA) was made of the Brayton Isotope Power System Ground Demonstration System (BIPS-GDS). Details of the analysis are discussed. The BIPS-FS FMECA was reviewed and determined to be essentially current. ERA

N77-27527# California Univ., Livermore. Lawrence Livermore Lab.
WIND POWER STUDIES: REGIONAL WIND ENERGY MEASUREMENTS Progress Report, Jul. - Sep. 1976
Donald M. Hardy 1 Nov. 1976 12 p refs
(Contract W-7405-eng-48)
(UCRL-50034-76-4) Avail: NTIS HC A02/MF A01

The wind power field measurement program which is being conducted in conjunction with numerical analyses of regional wind energy is discussed. Early examples of data collected in the program are given, including data confirming the existence of a broad area of high wind speeds which were predicted in previous numerical analyses. The measurement program is described, and plans for further numerical analysis and the continuation of the measurement program are discussed. ERA

N77-27528# AiResearch Mfg. Co., Phoenix, Ariz.
PRELIMINARY EVALUATION OF THE MINI-BRU TURBINE PLENUM IN SUPERALLOY AND THE CURRENTLY AVAILABLE HEAT EXCHANGER FOR THE BIPS WORKHORSE SYSTEM
S. J. Yang 11 May 1976 11 p
(Contract EY-76-C-03-1123)
(TID-27277) Avail: NTIS HC A02/MF A01

The Mini-BRU turbine plenum and nozzle assembly in superalloy and the currently available heat exchanger were examined for the BIPS workhorse system. Waspaloy can be used as the material of construction for the plenum and nozzle assembly. The heat exchanger can be utilized in the workhorse system with recommended modification. ERA

N77-27529# AiResearch Mfg. Co., Phoenix, Ariz.
TEST PLAN: BRAYTON ISOTOPE POWER SYSTEM GROUND DEMONSTRATION SYSTEM (BIPS-GDS)
13 Jun. 1976 49 p
(Contract EY-76-C-03-1123)
(TID-27299) Avail: NTIS HC A04/MF A01

An overall outline of all testing to be accomplished on the GDS is presented. Included in this test plan are administrative requirements, instrumentation accuracies, instrumentation, equipment definitions, system test setup, and facility installation. ERA

N77-27530# AiResearch Mfg. Co., Phoenix, Ariz.
BRAYTON ISOTOPE POWER SYSTEM (BIPS). PHASE 1: INTEGRATED PROGRAM PLAN (IPP)
27 May 1976 62 p
(Contract EY-76-C-03-1123)
(TID-27300; AiResearch-75-311574A) Avail: NTIS HC A04/MF A01

BIPS program coordination efforts are discussed. These coordination efforts are essential for defining program objectives, and achieving these objectives in an efficient manner. The IPP outlines a long range effort intended to: (1) develop end product confidence; (2) identify government and contractor activities pertinent and contributory to BIPS development; (3) recommend government and contractor activities required to ensure BIPS program success; (4) establish activity priorities based on program cost and schedule impacts, and achievement of technical objectives, (5) coordinate the efforts of contributing agencies; (6) provide general information and, to a limited extent, BIPS program-related development activity status to interested individuals and agencies; and (7) provide contractor team program planning guidance. ERA

N77-27531# AiResearch Mfg. Co., Phoenix, Ariz.
BRAYTON ISOTOPE POWER SYSTEM (BIPS) FACILITY SPECIFICATION
31 May 1976 89 p
(Contract EY-76-C-03-1123)
(TID-27256) Avail: NTIS HC A05/MF A01

General requirements for the Brayton Isotope Power System (BIPS)/Ground Demonstration System (GDS) assembly and test facility are defined. The facility will include provisions for a complete test laboratory for GDS checkout, performance, and endurance testing, and a contamination-controlled area for assembly, fabrication, storage, and storage preparation of GDS components. Specifications, schedules, and drawings are included. ERA

N77-27532# Wisconsin Univ., Madison. Solar Energy Lab.
SIMULATION STUDY OF SOLAR HEAT PUMP SYSTEMS
V. D. Karman, T. L. Freeman, and J. W. Mitchell 1976 17 p refs Presented at Joint Conf. of Am. Section of Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Inc., Winnipeg, Manitoba, 15-20 Aug. 1976
(Contract EY-76-S-02-2588)
(CONF-760842-10) Avail: NTIS HC A02/MF A01

The performance of several configurations of solar-augmented heat pump systems are evaluated. These systems include both air and water collection systems with either air-air, water-air, or special hybrid heat pumps which can use both stored energy and ambient air as energy sources. The performance evaluations employ factorial design to determine the effect of the parame-

ters of each individual system. The systems are compared with each other and with conventional solar and conventional heat pump systems. Simulations are done for Madison, Wisconsin; Albuquerque, New Mexico; and Charleston, South Carolina, to investigate climatological effects on solar heat pump performance. The results are used to formulate general guidelines for designing solar-augmented heat pump systems. ERA

N77-27533# Wisconsin Univ., Madison.
PARAMETRIC STUDY OF CRITICAL FUEL COSTS FOR SOLAR HEATING IN NORTH AMERICA
J. A. Duffie, W. A. Reckman, and M. J. Brandemuehl 1976 13 p Presented at Joint Conf. of the Amer. Sec. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Inc., Winnipeg Manitoba, Canada, 15 Aug. 1976
(Contract EY-76-S-02-2588)
(CONF-760842-12) Avail: NTIS HC A02/MF A01

Critical fuel energy cost, C/sub F/, is defined as the cost of delivered energy from conventional sources below which heat from optimized solar systems is more expensive than heat from conventional sources. The critical fuel energy cost is a useful index to assess the feasibility of solar heating in any location or region. A method is presented for estimating C/sub F/ for particular locations, buildings, solar collectors, and solar heating system costs. Tables are presented which permit determination of C/sub F/ as a function of system costs for 96 stations in the United States and Canada. Examples of C/sub S/ are shown for two of these stations. ERA

N77-27534# Wisconsin Univ., Madison. Solar Energy Lab.
SIMULATION STUDY OF SEVERAL SOLAR HEATING SYSTEMS WITH OFFPEAK AUXILIARY
P. J. Hughes, W. A. Beckman, and J. A. Duffie 1976 19 p refs Presented at Joint Conf. of the Amer. Sec. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Inc., Winnipeg, Manitoba, Canada, 15 Aug. 1976
(Contract EY-76-S-02-2588)
(CONF-760842-13) Avail: NTIS HC A02/MF A01

Solar air heating systems are compared using simulation methods. Two basic types of offpeak systems have been studied; Systems 1 and 2 which separate the storage of auxiliary and solar energy, and Systems 3 and 4, which store all energy in the same pebble bed. Simulation methods are used to determine the effect of system configuration, collector loss coefficient, controls, storage size and collector flow rate on system performance. ERA

N77-27535# Wisconsin Univ., Madison. Solar Energy Lab.
REVIEW OF SOLAR COOLING
J. A. Duffie and W. A. Beckman 1976 14 p refs Presented at Joint Conf. of the Amer. Sect. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Inc., Winnipeg, Manitoba, Canada, 15 Aug. 1976
(Contract EY-76-S-02-2588)
(CONF-760842-9) Avail: NTIS HC A02/MF A01

The future of cooling is linked to component (collector and storage) development. It is also closely interrelated with developments in solar heating as the economics of the two processes appear to be better than that of either one alone. ERA

N77-27536# Argonne National Lab., Ill.
DESIGN PROBLEMS ASSOCIATED WITH THE USE OF EVACUATED GLASS RECEIVERS FOR SOLAR COLLECTORS
J. W. Allen, W. S. Schertz, and N. M. Levitz 1976 18 p refs Presented at 21st Symp. of the Amer. Sci. Glassblowers Soc., Chicago, Ill., 7 Jun. 1976
(Contract W-31-109-eng-38)
(CONF-7606128-1) Avail: NTIS HC A02/MF A01

The design of evacuated receivers being used with a compound parabolic concentrator (CPC) is discussed, and means of minimizing optical and thermal losses are described. Emphasis is placed on the identification of problems that need attention by the glass industry. An evacuated receiver designed for use with a lightweight, thermoformed plastic 3x CPC is used as an example. ERA

N77-27537# California Univ., Livermore. Lawrence Livermore Lab.
DESIGN AND BEHAVIOR OF RIBLESS SOLAR REFLECTORS Ph.D. Thesis
R. A. Hyde 21 Dec. 1976 297 p refs
(Contract W-7405-eng-48)
(UCRL-52191) Avail: NTIS HC A13/MF A01

A thin, shallow, orbiting solar reflector could retain its shape without either being mounted on a rigid truss or by being spun. In order to apply pointing torques to the reflector and to keep it in equilibrium as the gravity gradient forces and its attitude vary, it would be necessary to have some active control over out-of-plane surface forces. This control could be achieved by varying the reflector's shape, which would deviate from flatness by approximately less than 1 part in 100. Power from thin, low efficiency solar cells could be used to control the thermal stresses in the reflector, and thus its shape. Large, approximately 5 km, diameter reflectors could remain in tension while operating in stable Sun-polar orbits, for half of the time they reflected sunlight to the Earth, while the rest of the time would be devoted to attitude maneuvers to precess the orbital plane. Large scale use of these large, light, easy to deploy reflectors in the stable Sun-polar orbit might make it possible to augment the Earth's solar energy influx, and to control its climate. ERA

N77-27538# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
GEOTHERMAL R AND D PROJECT Technical Report, 1 Apr. - 30 Jun. 1976
J. F. Kunze, ed. Oct. 1976 59 p refs
(Contract EY-76-C-07-1570)
(TREE-1008) Avail: NTIS HC A08/MF A01

Progress during April to July 1976 in research on geothermal energy is reported. The experiments are performed in the Raft River Valley, Idaho, a hydrothermal resource site with water temperatures below 150 C. During this period, a third well, RRGE-3 was drilled, and well production was tested, testing of a direct contact heat exchanger continued, design and cost estimating continued on a 40 MW (th) organic-binary heat exchange facility, agricultural studies of irrigation with geothermal water progressed, and down-hole data was obtained from RRGE-3. ERA

N77-27539# General Atomic Co., San Diego, Calif.
GAS TURBINE HTGR PROGRAM Quarterly Progress and Task Closeout Report, for period ending 30 Sep. 1976
Oct. 1976 248 p refs
(Contract E(04-3)-0167)
(GA-A-14097) Avail: NTIS HC A11/MF A01

A status summary of the research and development of the power plant is presented. The basis for the performance estimates at 850 C and 950 C core outlet temperatures, overall plant efficiency of over 50 percent for the latter case as a binary-cycle plant, and component design requirements for the elevated temperature case and the conceptual designs at various ammonia bottoming-cycle components are described. A review of plant safety is presented, including that for the binary-cycle plant. Mechanically and aerodynamically improved designs for the turbomachines are described, based upon test data from the FT-50 engine, from use of a welded turbine rotor, from mounting two compressor stages per disk, and from alternate material selection. Studies of a core having an outlet temperature of 950 C and favorable conversion ratio and neutronics are described. Control studies, fission product plateout studies, and material testing in helium are summarized. Balance-of-plant layouts and requirements are described. Advances in PCRV and internals are discussed. The status of heat exchangers and control valves is reviewed. ERA

N77-27540# Wisconsin Univ., Madison.
PERFORMANCE OF A SOLAR HEATING SYSTEM UTILIZING PHASE-CHANGE ENERGY STORAGE
D. J. Morrison and S. I. Abdel-Khalik 1976 14 p refs Presented at Joint Conf. of the Amer. Sec. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Inc., Winnipeg, Manitoba, Canada, 15 Aug. 1976
(Contract EY-76-S-02-2588)
(CONF-760842-11) Avail: NTIS HC A02/MF A01

A model describing the transient behavior of a phase-change energy storage (PCES) unit is presented. Simulation techniques are used in conjunction with this model to determine the performance of a solar air-heating system utilizing PCES. The effects of storage size and heat transfer characteristics on the system performance are investigated. Optimum ranges of storage sizes are given for systems with paraffin wax and sodium sulfate decahydrate as storage media. Comparison is made between two similar systems with sensible heat and solar-supplied fraction of the load over the heating season are given for both systems. Actual weather data for the Madison area are used in these simulations. ERA

N77-27541# Sandia Labs., Albuquerque, N. Mex.
NONBIOLOGICAL PHOTOCHEMICAL ENERGY CONVERSION, CAN IT COMPETE
R. W. Harrigan 1976 24 p refs Presented at Amer. Chem. Soc. Pacific Conf., Phoenix, Ariz., 7 Nov. 1976
(Contract E(29-1)-789)
(SAND-76-5763; Conf-761135-1) Avail: NTIS HC A02/MF A01

The results of an analysis of a combined photovoltaic/thermal system applied to meeting a community energy demand are reported. ERA

N77-27542# Federal Energy Administration, Washington, D. C. Office of Coal Utilization.
COAL CONVERSION PROGRAM. ENERGY SUPPLY AND ENVIRONMENTAL COORDINATION ACT (AS AMENDED). SECTION 2
Feb. 1977 622 p refs
(PB-265815/1; FEA/G-77/061; DES-77/3) Avail: NTIS HC A99/MF A01 CSCL 13B

The Federal Energy Administration's authorities under ESECA are discussed. These include prohibiting fossil fuel fired facilities from burning natural gas or petroleum products as their primary energy source. The agency also has the power to require facilities in the early planning process to be built with the capability of burning coal. The probable environmental impacts associated with issuing such orders are considered. GRA

N77-27543# Atomics International, Canoga Park, Calif.
SYSTEMS FOR NUCLEAR AUXILIARY POWER Annual Report, Government FY 1976/TQ
30 Sep. 1976 162 p refs
(Contract E(04-3)-0701)
(AI-ERDA-13179) Avail: NTIS HC A08/MF A01

System and component engineering activities relating to the zirconium hydride (ZrH) reactor are described. The specific objectives for FY 1976/TQ were to: (1) study standardized ZrH reactor space power systems and components, (2) perform preconceptual analysis and design of ZrH reactor-organic Rankine power systems for subsea applications, (3) conduct fuel and hydrogen barrier investigations, (4) perform system studies in support of the Department of Defense and their contractors as directed by ERDA, (5) test components, and (6) provide for material disposal and facility surveillance. Representative systems which utilize Brayton, Rankine, and Stirling cycle power conversion units as well as thermoelectric modules, were analyzed at power levels of 10, 25, 50, and 75 kWe. Waste heat rejection is accomplished by concentric, cylindrical space radiators which can be nested during launch for space shuttle integration. ERA

N77-27544# Argonne National Lab., Ill.
DEVELOPMENT OF LIGHTWEIGHT COMPOUND PARABOLIC CONCENTRATORS FOR SOLAR THERMAL ELECTRIC AND PROCESS HEAT APPLICATIONS
J. W. Allen, N. M. Levitz, A. Rabl, K. Reed, W. S. Schertz, and R. Winston 1976 12 p refs Presented at the Solar Energy Conf., Winnipeg, Canada, 15-20 Aug. 1976
(Contract W-31-109-eng-38)
(CONF-760842-16) Avail: NTIS HC A02/MF A01

The design and construction of a lightweight collector panel that uses the compound parabolic concentrator (CPC) to achieve maximal concentration with minimal tracking requirements is described. The primary goal of the effort was the development of methods of constructing the units with low cost materials that still allowed high temperature (120 to 230 C) operation. The use of thermoformed plastics for both the container box and the reflector substrate was investigated for use in combination with an evacuated glass tube around the absorber plate. The predicted performance of the collector was calculated, and the problem of keeping the reflectors cool was addressed. Preliminary results of reflector tests are presented. ERA

N77-27545# Argonne National Lab., Ill. Solar Energy Group.
INSTRUMENTATION FOR MEASURING DIRECT AND DIFFUSE INSOLATION IN TESTING THERMAL COLLECTORS
Kent A. Reed 1976 11 p refs Presented at 20th Ann. SPIE Tech. Symp. on the Appl. and Util. of Opt., Electro-Opt., Laser and Phot. Technol., San Diego, Calif., 23-27 Aug. 1976
(Contract W-31-109-eng-38)
(CONF-760832-23) Avail: NTIS HC A02/MF A01

The use of pyranometers to measure the total insolation as well as the insolation within specified angular fields of view, together with a normal incidence pyrheliometer to measure the direct beam component, is described. The instrument calibration procedure is discussed, and data are presented. ERA

N77-27546# Battelle Pacific Northwest Labs., Richland, Wash.
OPTIMIZATION TECHNIQUE FOR GEOTHERMAL POWER PLANTS USING A BINARY FLUID CYCLE
S. W. Wilson and R. A. Walter Oct. 1976 33 p refs
(Contract EY-76-C-06-1830)
(BNWL-2155) Avail: NTIS HC A03/MF A01

A comprehensive computer model of a binary fluid cycle power plant for use with geothermal resources was developed. This computer model can be used to assess the technical and economic feasibility of the geothermal resource and to aid in the design of binary power plants. An optimization technique was developed to rapidly select the power plant design with the highest utilization efficiency based upon the maximum use of available energy in the geothermal field. This optimization technique has shown a close correlation with the minimum cost of power and can be used to easily select a minimum cost geothermal plant design knowing the geothermal fluid temperature, the prevailing ambient temperature for heat rejection, and the selected working fluid. ERA

N77-27547# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ASSESSMENT OF ENERGY STORAGE TECHNOLOGIES AND SYSTEMS. PHASE 1: ELECTRIC STORAGE HEATING, STORAGE AIR CONDITIONING, AND STORAGE HOT WATER HEATERS
J. Asbury, R. Giese, S. Nelson, L. Akridge (TRW Energy Systems Group, McLean, Va.), P. Graf (TRW Energy Systems Group, McClean, Va.), and K. Heitner (TRW Energy Systems Group, McLean, Va.) Aug. 1976 78 p refs
(Contract W-31-109-eng-38)
(ANL-ES-54) Avail: NTIS HC A05/MF A01

The commercial feasibility of thermal energy storage (TES) in buildings is analyzed. TES applications examined include storage electric (resistance) heating, storage air conditioning, and storage hot water heating. A system model, SIMSTOR, is employed to simulate TES-related effects upon daily and annual utility load profiles and to compare utility fuel and capital cost savings with TES-system costs. Case-study analyses of TES applications for a representative set of utility service areas indicate that several already and near-commercial TES systems are cost-effective. Alternative strategies to commercialize these systems are examined and the preferred strategies are identified. ERA

N77-27548# California Univ., Livermore. Lawrence Livermore Lab.
HYDROGEN STORAGE BY BINARY AND TERNARY INTERMETALLICS FOR ENERGY APPLICATIONS: A REVIEW
H. W. Newkirk 2 Aug. 1976 98 p refs Supersedes UCRL-51244
(Contract W-7405-eng-48)
(UCRL-52110; UCRL-51244) Avail: NTIS HC A05/MF A01

Binary and ternary intermetallic compounds are being considered as a possible solution to storage problems in the use of hydrogen as an alternative fuel for many applications.

For selected systems, this report reviews and summarizes theories of storage optimization, experimental procedures, property data, potential applications for stationary and mobile energy storage, resource and economic analyses, and safety factors. The systems surveyed are those binary, ternary, and complex intermetallic compounds containing a member of the transition element series, a member of the rare earth series, and/or a member of the actinide series. ERA

N77-27549# Wilson, Jones, Morton and Lynch, San Mateo, Calif.

SANTA CLARA, CALIFORNIA, COMMUNITY CENTER, COMMERCIAL SOLAR DEMONSTRATION LEGAL ALTERNATIVES, IMPLICATIONS, AND FINANCING OF SOLAR HEATING AND COOLING BY A MUNICIPAL CORPORATION

Sharon S. White, T. S. Owen, R. A. Ryan, T. A. Scott, S. F. Lucey, K. I. Jones, and P. D. Assaf Sep. 1976 135 p refs Sponsored in part by the City of Santa Clara
(Contract E(04-3)-1083)
(SAN/1083-76/1) Avail: NTIS HC A07/MF A01

The legal issues confronting municipal corporations who propose to provide for solar energy utilization within their jurisdictions are many. Generally, however, such issues may be resolved in favor of most proposed forms of utilization based upon traditional legal principles. Threshold issues confronting any municipal utilization relate to the impact purpose. Previous judicial decisions indicate that an action by a private utility against a municipal corporation based upon impairment of contract, taking of property without compensation, unfair competition or antitrust violation would not be successful. ERA

N77-27550# Martin Marietta Corp., Denver, Colo.

CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM, PHASE 1 Final Quarterly Progress Report, period ending 31 Mar. 1976

Oct. 1976 118 p
(Contract E(04-3)-1110)
(SAN/1110-76/1; MCR-76-131) Avail: NTIS HC A06/MF A01

Both twenty-five mirror and nine mirror heliostats were designed for the collector subsystem. The detail design of the 5 MW research experiment receiver was further developed. A preliminary draft of the detailed test plan for the receiver subsystem research experiment was prepared and the detailed design of the thermal storage subsystem continued. A preliminary environmental analysis was completed for the pilot plant. Optimization studies of the electrical power generation system were initiated. A preliminary cost analysis was prepared for the 10 MWe central receiver solar thermal pilot plant. This task required the development of a cost accounting structure and a definition of all of the costs associated with the design, construction, checkout, and two year test of the pilot plant. ERA

N77-27551# Martin Marietta Corp., Denver, Colo.

CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM, PHASE 1 Final Quarterly Progress Report, period ending 30 Jun. 1976

Oct. 1976 128 p
(Contract E(04-3)-1110)
(SAN/1110-76/2; MCR-76-296) Avail: NTIS HC A07/MF A01

Effort was continued in the evaluation of pilot plant start transients. Both warm and hot starts from thermal storage were evaluated as was a cold start from the receiver. In the collector subsystem experiment, the heliostat structures and drive mechanisms were completed and delivered. The detail design of the 5 MW receiver experimental was completed. In the thermal storage subsystem the detail design of the experiment was completed. A final selection of the heat transport media was made with Hitec selected as the molten salt and Caloria HT-43 selected as the hydrocarbon oil. Bechtel continued its efforts in the optimization of the electrical power generation subsystem. ERA

N77-27552# Sandia Labs., Albuquerque, N. Mex.

SILICON SOLAR CELL TESTING IN CONCENTRATED SUNLIGHT AND SIMULATED SUNLIGHT

E. L. Burgess and K. W. Mitchell 1976 9 p refs Presented at Terrest. PV Meas. Workshop, Baton Rough, La., 10 Nov. 1976
(Contract E(29-1)-789)
(SAND-76-9063; Conf-761129-2) Avail: NTIS HC A02/MF A01

A method is described for testing silicon solar cells in concentrated sunlight and simulated sunlight. Concentrated sunlight is obtained using an acrylic Fresnel lens; the simulated sunlight source is a short arc xenon lamp. Average illumination levels during the tests are inferred from an assumed linear relationship between short circuit current and illumination. This linearity assumption was investigated for 0.30-cm base resistivity silicon cells and found to be valid. Some typical results are presented to illustrate the type of information obtained during the testing. ERA

N77-27553# Sandia Labs., Albuquerque, N. Mex.

HYDROGEN COMPATIBILITY OF STRUCTURAL MATERIALS FOR ENERGY STORAGE AND TRANSMISSION APPLICATIONS Semiannual Report, period ending 1 Oct. 1976

S. L. Robinson, comp. Dec. 1976 69 p refs
(Contract E(29-1)-789)
(SAND-76-8255) Avail: NTIS HC A04/MF A01

The suitability of commercial alloys for containment of hydride-dehydride reactions was assessed, and recommendations for materials selection based upon tensile and slow crack growth tests were made. A series of in situ test specimens was prepared for exposure to a cyclic iron-titanium hydride environment. A preliminary welding specification for containment of hydrogen in structural mild steels was developed. Hydrogen permeation resistant coatings, applied by pyrolysis of silane and brush electroplating, were developed. Environmentally assisted, cyclic fatigue in high pressure hydrogen was identified as a potential hazard to the integrity of flawed pressure vessels in materials where slow crack growth under a constant load is not expected. ERA

N77-27554# Waterloo Univ. (Ontario).

STUDIES ON METHODS OF REDUCING HEAT LOSSES FROM FLAT PLATE SOLAR COLLECTORS Progress Report, 1 Aug. 1974 - 31 Jan. 1976

K. G. T. Hollands, G. D. Raithby, and T. E. Unny Jun. 1976 137 p refs
(Contract E(11-1)-2597)
(COO-2597-2) Avail: NTIS HC A07/MF A01

Improvements to flat plate solar collectors for heating and cooling of buildings were evaluated through three parallel studies. The first study has demonstrated suppression of free convection by a honeycomb at all angles of inclination. Reductions by a factor of 5 in the free convective heat loss are reported, and equations and charts permitting the rational design of honeycombs for convection suppression in solar collectors are presented. The second study has resulted in a precise, easily programmable set of equations for the free convective heat loss through the air gaps in flat plate solar collectors, for any angle of tilt. The third study has theoretically and experimentally demonstrated that the solar transmittance of a flat transparent cover for a solar collector can be very substantially increased by V-corrugating. Since V-corrugating should also decrease the free convective and radiant losses, substantial improvements in collector efficiency are predicted. ERA

N77-27555# Argonne National Lab., Ill. Div. of Environmental Impact Studies.

EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES

Ishwar P. Murarka, Anthony J. Policastro, John G. Ferrante, Edward W. Daniels, and Gary J. Marmer Nov. 1976 30 p
(Contract W-31-109-eng-38)
(ANL-EIS-8) Avail: NTIS HC A02/MF A01

An analysis of the fuel data gathered during the monitoring programs at seven nuclear power plant sites shows no significant ecological impacts. This conclusion is within the constraints of the quality of available data from these sites. Current monitoring programs, however, are not designed to meet the needs for statistical analysis, and, consequently, the monitoring data are

often ill-suited for modern statistical procedures. Recommendations are proposed for revising monitoring schemes so that more precise conclusions can be made from fewer field measurements. ERA

N77-27556# Sea Solar Power, Inc., York, Pa.
DESIGN OF COLD WATER PIPE FOR SEA THERMAL POWER PLANTS Progress Report, 1 May 1975 - 30 May 1976
J. Hilbert Anderson Jun. 1976 56 p refs
(Contract E(11-1)-2691)
(COO-2691-2) Avail: NTIS HC A04/MF A01

Preliminary analysis is performed on a flexible pipe support system capable of isolating the pipe from the platform during any sea state likely to be encountered by a sea thermal power plant. It is concluded that the basic design is feasible and justifies more precise analysis. ERA

N77-27557# Army Electronics Command, Fort Monmouth, N. J. Electronics Technology and Devices Lab.
TRANSITION METAL COMPOUNDS AS CATHODIC MATERIALS IN RECHARGEABLE LITHIUM CELLS
Robert F. Hunger and Joseph E. Ellison Feb. 1977 20 p refs
(AD-A037676; ECOM-4474) Avail: NTIS HC A02/MF A01 CSCL 10/3

A comparison was made between rechargeable lithium batteries, based on lithium intercalation or lithium interstitial compounds of transition metal chalcogenides or oxides, and nickel-cadmium batteries. Several chalcogenides and oxides show promise as cathodic materials. Preliminary experimental work was done with lithium-molybdenum trioxide cells. The polarization characteristics of the molybdenum trioxide cathode were studied, and some insight in the reaction mechanism was gained. In charge discharge experiments, the capacity loss after deep cycling was explored; the energy efficiency and the energy content of the system were determined. Author (GRA)

N77-27558# Air Force Academy, Colo. Frank J. Seiler Research Lab.
EXPERIMENTAL OPTIMIZATION AND CHARACTERIZATION OF A LiAl/NaAlCl4/MoCl5 PELLETIZED THERMAL CELL Technical Report, Jun. 1975 - Feb. 1977
John C. Nardi, John K. Erbacher, Charles L. Hussey, and Lowell A. King Feb. 1977 44 p refs
(AF Proj. 2303)
(AD-A039087; FJSRL-TR-77-0002) Avail: NTIS HC A03/MF A01 CSCL 10/3

A new molten salt thermally activated reserve battery utilizing immobilized liquid NaAlCl4 as the electrolyte is described. Lithium-aluminum alloys are employed as anodes with a cathode of MoCl5 in intimate contact with a powdered graphite current collector. The optimization of the battery with respect to anode, electrolyte and catholyte composition was investigated. Battery discharge behavior was characterized, defining optimum conditions of temperature and discharge rate to produce maximum energy output. The optimal cell configuration delivered 38 W-hr/lb at a discharge rate of 15 mA/square cm at 175 C. The first application of a derivative discharge function to thermal cell analysis characterizes the complex discharge mechanism. Author (GRA)

N77-27559# Federal Energy Administration, Washington, D. C. Office of Management and Administration.
[MID-TERM AND LONG TERM ENERGY TRENDS] Annual Report, 1975 - 1976
Jan. 1977 164 p
(PB-264740/2; FEA/F-77/089) Avail: NTIS HC A08/MF A01 CSCL 10A

Positive energy accomplishments for the Nation and her citizens in Fiscal Year 1976 are described. The mid-term outlook and long-term trends for the various energy sources are noted. A list of contracts awarded and a summary of information-gathering activities are included. GRA

N77-27560# Federal Power Commission, Washington, D. C. Bureau of Power.
FACTORS AFFECTING THE ELECTRIC POWER SUPPLY, 1980-85: EXECUTIVE SUMMARY AND RECOMMENDATIONS
1 Dec. 1976 55 p refs
(PB-264760/0) Avail: NTIS HC A04/MF A01 CSCL 10B

The overall nationwide supply of electric power and major potential problems which can adversely affect regional power supplies during the 1980-1985 period are discussed. GRA

N77-27561# Maine Univ., Orono. Dept. of Electrical Engineering.
TERNARY COMPOUND THIN FILM SOLAR CELLS - I Quarterly Report, 1 Sep. - 31 Dec. 1976
L. L. Kazmerski Jan. 1977 68 p refs Sponsored in part by ERDA
(Grant NSF AER-75-19576-A01)
(PB-265003/4; NSF/RA-760448; QR-1) Avail: NTIS HC A04/MF A01 CSCL 10B

The electrical properties - mobility, conductivity, carrier type and carrier concentration - are reported. A thin-film CdS/CuInTe2 heterojunction has been fabricated. Dark IV-characteristics are presented for in-situ provided devices. The photovoltaic effect for this heterostructure is discussed. Finally, the fabrication and characterization of n,p-CuInS2 thin film homojunction solar cells are presented. GRA

N77-27562# Economic Research Service, Washington, D. C.
ENERGY AND US AGRICULTURE. 1974 DATA BASE, VOLUME 1. PART A: US SERIES OF ENERGY TABLES. PART B: STATE SERIES OF ENERGY TABLES
R. T. VanArsdale and E. Rall Sep. 1976 266 p
(PB-264449/0; FEA/D-76/459) Avail: NTIS HC A12/MF A01 CSCL 02D

Energy consumption estimates are presented for both national and state levels by fuel type, fertilizer and pesticides, by commodity, by month, and by categories of functional use, including irrigation and crop drying. GRA

N77-27563# National Bureau of Standards, Washington, D. C. Metallurgy Div.
PREVENTION OF FAILURES IN COAL CONVERSION SYSTEMS: PRODEEDINGS OF THE 24TH MEETING OF THE MECHANICAL FAILURES PREVENTION GROUP
T. Robert Shives and William A. Willard Apr. 1977 237 p refs Conf. Proc. held at Columbus, Ohio, 21-23 Apr. 1976 Sponsored in part by Frankford Arsenal, ONR, FAA, ERDA, NADC, and Battelle Columbus Labs.
(PB-265552/0; NBS-SP-468; LC-77-608043) Avail: NTIS HC A11/MF A01 CSCL 07A

A series of overview lectures dealing with reliability problems in coal conversion systems, economics of failures in energy generating systems, corrosion, and gaps in engineering data are presented. In addition, failure analysis, materials problems, and related materials research are discussed. GRA

N77-27564# Systems Science and Software, La Jolla, Calif.
COMPUTER SIMULATION OF GEOTHERMAL RESERVOIRS
D. H. Brownell, Jr., S. K. Garg, and J. W. Pritchett 1975 11 p refs Presented at 45th Ann. Calif. Regional Meeting of the Soc. of Petrol. Eng. of AIME, Ventura, Calif., 2-4 Apr. 1975 Prepared in cooperation with Colorado. Univ., Boulder
(Grants NSF GI-43884; NSF GI-44212)
(PB-265104/0; NSF/RA/N-75-352; SPE-5351) Avail: NTIS HC A02/MF A01 CSCL 08I

General balance laws and constitutive relations are developed for convective hydrothermal geothermal reservoirs. A fully interacting rock fluid system is considered; typical rock-fluid interactions involve momentum and energy transfer, and the dependence of rock porosity (and permeability) upon the fluid and rock stresses. The mathematical model also includes multiphase (water/steam) effects. The geologic stress-strain behavior treatment permits the highly nonlinear and history-dependent constitutive behavior of the material to be properly taken into account. GRA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N77-27565 North Carolina Univ., Chapel Hill.
OZONE-PRECURSOR RELATIONSHIPS OF NITROGEN DIOXIDE, ISOPENTANE, AND SUNLIGHT UNDER SELECTED CONDITIONS Ph.D. Thesis
Joseph Edward Sickles, II 1976 299 p
Avail: Univ. Microfilms Order No. 77-2096

The ozone-producing potential of isopentane and nitrogen dioxide mixtures exposed to natural sunlight irradiation and temperature was investigated. Mixtures of isopentane, NO2, and water vapor were subjected to single day (10 hour) exposures to natural sunlight irradiation and temperature in bag reactors fabricated from Teflon film. A six by seven experimental design was employed with initial isopentane concentrations from 0.00 to 1.00 ppmC and NO2 concentrations from 0.00 to 0.10 ppm. The initial water vapor concentration was 6,800 ppm. Calculated initial concentrations, k sub 1 profiles, ozone profiles, and ozone maxima were measured. Using the maxima, an ozone generation surface was defined and was used to address the nonurban high ozone problem. Dissert. Abstr.

N77-27566 Purdue Univ., Lafayette, Ind.
A NUMERICAL STUDY OF RADIATIVE EFFECTS OF POLLUTANTS ON THERMAL STRUCTURE AND POLLUTANT DISPERSAL IN THE PLANETARY BOUNDARY LAYER Ph.D. Thesis
Akula Venkatram 1976 263 p
Avail: Univ. Microfilms Order No. 77-1789

The first part of the investigation consisted of the construction of a one-dimensional numerical model of the boundary layer. The model incorporated the two-stream method for the computation of radiative fluxes in the solar spectrum, and the turbulent kinetic energy model to account for turbulence. A series of numerical experiments was performed to determine the role of pollutants in modifying thermal structure and pollutant dispersal in the boundary layer. The results of the experiments showed that the predominant influence of gaseous and particulate pollutants on the surface temperature was one of warming. Under the conditions investigated the reduction of solar flux at the surface was not accompanied by a decrease in the surface temperature. The second phase of the study involved the construction of a two-dimensional numerical model to study the effects of pollutants on urban-rural differences in thermal structure and pollutant dispersal. Results of numerical experiments showed that radiative participation by pollutants increased the maximum urban heat island intensity by as much as 50%. Dissert. Abstr.

N77-27567*# Kanner (Leo) Associates, Redwood City, Calif.
THE POSITION OF GAS TURBINE POWER PLANTS WITH RESPECT TO THE EMISSION OF NITROGEN OXIDES BY FOSSIL-FUELED ENERGY INSTALLATIONS
Erwin Kaiser Washington NASA Jul. 1977 11 p refs Transl. into ENGLISH from Energietech. (Leipzig), v. 26, no. 3, 1976 p 132-134 Original language document was announced as A76-40337
(NASA-TM-75126) Avail: NTIS HC A02/MF A01 CSCL 13B

The amount of nitrogen oxides introduced into the atmosphere by gas turbines is very significant in relation to the total amount of nitrogen oxide emissions produced by chemical installations and combustion engines. Turbine manufacturers are therefore working to develop combustion chambers with sufficiently low nitrogen oxide emission concentrations. Attention is given to aspects of nitrogen oxide formation in gas turbines, the parameters which determine this formation, and suitable approaches to reducing nitrogen oxide emissions. Author

N77-27568*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INTERHEMISPHERIC SURVEY OF MINOR UPPER ATMOSPHERIC CONSTITUENTS DURING OCTOBER - NOVEMBER 1976
Daniel J. Gauntner, comp. and Louis C. Haughney, comp. (NASA, Ames Res. Center) Mar. 1977 201 p refs
(NASA-TM-X-73630; E-9130) Avail: NTIS HC A10/MF A01 CSCL 13B

The CV-990 aircraft coordinated several flights with a NASA U-2 aircraft, NOAA ground station measurements in Alaska, Hawaii, and American Samoa, and with Australian and New Zealand ground stations, aircraft, and a balloon experiment in the Southern hemisphere. Data were obtained for species including ozone, total ozone, the oxides of nitrogen, the chlorofluoromethanes, water vapor, nitric acid, carbon monoxide, carbon dioxide, hydrogen chloride, Aitken nuclei, ammonia, aerosols, temperatures, and winds. Individual experiment results and selected analyses are presented. The experimental data include total column densities, latitude variations, interhemisphere differences, and vertical profiles. Author

N77-27569# NATO Committee on the Challenges of Modern Society, Brussels (Belgium).
PROCEEDINGS OF THE 7TH INTERNATIONAL TECHNICAL MEETING ON AIR POLLUTION MODELING AND ITS APPLICATION
1976 1110 p Conf. held at Airlie House, Va., 7-10 Sep. 1976
(Rept-51) Avail: NTIS HC A99/MF A01

Various aspects of air pollution modeling are discussed with emphasis on user requirements. Dispersion under low wind speeds, transformation of primary emissions into secondary air pollutants, transport of air pollutants over long distances or beyond national frontiers, and innovative modeling techniques are among the topics covered. For individual titles, see N77-27570 through N77-27609.

N77-27570 Texas Air Control Board, Austin.
TWO EFFICIENT GAUSSIAN PLUME MODELS DEVELOPED AT THE TEXAS AIR CONTROL BOARD
Richard A. Porter and John H. Christiansen *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 2-24 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

The Texas Climatological Model (TCM) and the Texas Episodic Model (TEM) are described. Predictions of long term average concentrations based on annual or seasonal climatology and short term average predictions based on specific meteorological scenarios are provided, respectively. The input/output features and options of the models are described along with examples of specific applications. A complete mathematical description of the various algorithms of the models is given. Author

N77-27571 Argonne National Lab., Ill. Energy and Environmental Systems Div.
AIR QUALITY MANAGEMENT UTILIZING AIR QUALITY MODELS
Donald M. Rote *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 25-49 (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

Air quality management and factors which govern the use of models in support of such management are discussed. The relationship between the regulatory approaches to air quality control and model utilization is examined. Particular emphasis is placed upon the decision maker or air quality manager as a user of models, the problems he is confronted with and the applications for which he uses models. The kinds of information the user requires in order to apply models, the types of models used, and the data requirements of models are also discussed. Author

N77-27572 Provincial Lab. of Hygiene and Prophylaxis, Milan (Italy).
APPLICATIONS OF MATHEMATICAL MODELS IN POLLUTION NETWORK PLANNING AND AIR QUALITY CONTROL
A. Cavallaro, R. Gualdi, G. Laneve (Osservatorio Meteorologyco di Brera), and G. Tebaldi *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 51-81 refs (For primary document see N77-27569 18-45)

Avail: NTIS HC A99/MF A01

Research into air pollution control and prevention in the Province of Milan is summarized. Urban micrometeorology and mathematical models, a network of chemical and meteorological sensors linked to a centralized computer, and a diffusion model which simulates the dynamics of the Milan atmosphere are discussed along with tests which simulate the effect of urban and industrial installations on air quality. J.M.S.

N77-27573 Environmental Research and Technology, Inc., Concord, Mass.

THE VALIDATION OF A GAUSSIAN PLUME POINT SOURCE DIFFUSION MODEL IN A LAKESHORE ENVIRONMENT

Lloyd L. Schulman, Thomas F. Lavery, and Steven G. Penansky *In* NATO Comm. of the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 83-111 refs (For primary document see N77-27569 18-45)

Avail: NTIS HC A99/MF A01

A Gaussian plume point source diffusion model was used to predict hourly sulfur dioxide (SO2) concentrations in the vicinity of a lake shore electric generating station in western New York State. These model calculations were compared with corresponding SO2 levels measured at eleven continuous SO2 monitors during the period 1 November 1974 to 31 October 1975. Concurrent wind direction, wind speed, and temperature data used as model input were recorded at two meteorological towers instrumented at 10, 50, and 100 m. Atmospheric mixing depths were derived from both onsite and National Weather Service radiosonde soundings. Results are summarized. Author

N77-27574 INTERA Environmental Consultants Ltd., Houston, Tex.

DIFFUSION MODEL COMPARISONS TO MEASURED DATA IN COMPLEX TERRAIN

R. B. Lantz, G. F. Hoffnagle, and S. B. Pahwa *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 119-142 refs (For primary document see N77-27569 18-45)

Avail: NTIS HC A99/MF A01

Data sets for several specific situations where plume interaction with elevated terrain occurred are compared using two Gaussian models and one numerical model. Good agreement is found between the numerical and the Gaussian model results over flat terrain, but in cases where terrain modifies the air flow the numerical model results differ substantially from the Gaussian model results. It is hypothesized that calculation of the air flow due to the influence of the terrain is essential to the subsequent calculation of the resultant ground level pollutant concentrations. J.M.S.

N77-27575 Norwegian Inst. for Air Research, Kjeller.

THE APPLICATION OF DISPERSION MODELS IN A FJORD VALLEY AREA OF NORWAY

Bjarne Sivertsen *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 143-168 refs (For primary document see N77-27569 18-45)

Avail: NTIS HC A99/MF A01

Different air pollution dispersion models were applied to a nonstationary meteorological situation governed by land/sea breeze and mountain valley wind. Calculation of the diurnal variation and the occurrence and magnitude of the maximum concentration in the populated valley area was emphasized. Concentrations of nitrogen oxides (NO plus NO2) were used in the validation of the models. The calculations demonstrate the importance of a proper windfield simulation in areas with complex topography. Straight lined trajectories applied to quasistationary Gaussian type disperson models do not reflect the diurnal concentration pattern observed in the test area. Calculations performed in selected test periods show that the use of nonstationary finite difference models improves the calculations considerably. Author

N77-27576 Royal Netherlands Meteorological Inst., De Bilt.

THE VALIDATION OF THE GAUSSIAN DISPERSION MODEL FOR LONG-TERM AVERAGE GROUND LEVEL CONCENTRATIONS IN THE RIJNMOND REGION

F. T. M. Nieunstadt, C. M. Verheul, and J. Addicks *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 169-218 refs (For primary document see N77-27569 18-45)

Avail: NTIS HC A99/MF A01

A Gaussian plume model was used to calculate the concentration of SO2 in the heavily industrialized Rijnmond region. The number of point sources taken into account was 87 and the number of area sources with dimensions of 1 x 1 km was 491. The area sources represent the emissions of agricultural and domestic heating and the emissions of the ships in the port of Rotterdam. The influence of a change of dispersion coefficients for the low sources and the area sources, the influence of the mixing height, deposition, and decay on the calculated concentrations, and the influence of a change of dispersion parameters and the plume rise formula of the point sources on the calculated concentrations were investigated. It is concluded that the dispersion coefficients for low sources should be corrected for the surface roughness in the area and that the combined contribution of the very high sources to the calculated concentrations at ground level is more sensitive to a change in the dispersion parameters than the total contribution of the other point sources. Author

N77-27577# Northrop Services, Inc., Research Triangle Park, N. C.

A DUAL TRACER STUDY FOR THE VALIDATION OF MODELS WITH RESPECT TO HIGH AND LOW ALTITUDE SOURCES

J. H. Overton, Jr., B. K. Lamb (Calif. Inst. of Tech., Pasadena, Calif.), F. H. Shair (EPS, Research Triangle Park, N. C.), and W. E. Wilson, Jr. *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 219-234 refs (For primary document see N77-27569 18-45)

Avail: NTIS HC A99/MF A01

The results of a tracer study performed to obtain specific transport and dispersion data from low and high altitude sources are discussed and compared with values calculated from an existing air quality model. Author

N77-27578 Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

VALIDATION OF THE EMISSION FREQUENCY DISTRIBUTION MODELS IN THE REGION OF ANTWERPEN, BELGIUM

J. G. Kretzschmar, G. Debaere, and F. Vandervee *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 235-270 refs (For primary document see N77-27569 18-45)

Avail: NTIS HC A99/MF A01

Preliminary results of tests on the validity of the Emission Frequency Distribution Model in the region of Antwerpen are reported. Weak points in the model and in its input data are identified in order to further optimize the model. The usefulness of certain validation procedures as a function of the objectives of the model was also evaluated. Author

N77-27579 Technische Hochschule, Darmstadt (West Germany). Inst. fuer Meteorologie.

PRELIMINARY RESULTS OF THE APPLICATION OF A STATISTICAL MODEL ON INTERREGIONAL TRANSPORT OF SO2

B. Dietzer *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 277-291 refs (For primary document see N77-27569 18-45)

Avail: NTIS HC A99/MF A01

A Dutch - German project was initiated to investigate the interregional transport of SO2 from the Ruhr area into the Netherlands. In the region between Ruhr area and the Netherlands a network of about 31 stations was set up, which measures hourly averages of the SO2 surface concentrations. The SO2 patterns are described with a statistical model. Author

N77-27580 Stanford Research Inst., Menlo Park, Calif.

THE EUROPEAN REGIONAL MODEL OF AIR POLLUTION (EURMAP) AND ITS APPLICATION TO TRANSFRONTIER AIR POLLUTION

Warren B. Johnson, Daniel E. Wolf, and Robert L. Mancuso *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 293-371 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

The model is designed to calculate long-term (monthly, seasonal, and/or annual) averages of the contributions from SO2 in individual emittor countries to concentrations, dry deposition, and wet deposition in receptor countries. An innovative trajectory-type approach is used, which involves the tracking of pollutant puffs released from each emissions cell in an extensive grid. Meteorological data in the form of wind and precipitation values are input at 6-hourly intervals for use in the calculations of puff transport and wet deposition. The model was used to calculate preliminary maps of concentration, dry deposition, and wet deposition patterns resulting from SO2 emissions in each of thirteen countries in Western and Central Europe, taken both individually and together. These results were used to prepare preliminary tables of the percent contributions of emittor countries to concentration, dry deposition, and wet deposition in receptor countries. Author

N77-27581 California Univ., Livermore. Lawrence Livermore Lab. Atmospheric and Geophysical Sciences Div.
RECENT ADVANCES IN THE SIMULATION OF REGIONAL AIR QUALITY
Joseph B. Know *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 373-408 refs (For primary document see N77-27569 18-45)
(Contract W-7405-eng-48)
(UCRL-78176) Avail: NTIS HC A99/MF A01

Regional air quality models for passive and reactive pollutants emitted from distributed sources or multiple point sources are described. Relating distributed and complex sources to the temporal spatial pollutant distributions that evolve through transport diffusion, chemical transformation, and deposition (or surface absorption) including effects of complex terrain is emphasized. Author

N77-27582 Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.
MODELING MOUNTAIN AIR QUALITY
Douglas G. Fox and Michael A. Fosberg *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 413-427 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

A sequence of modeling techniques that have been designed for use by managers responsible for mountainous lands is presented. The modeling package includes three fundamental, somewhat complex, components which are used to calculate simple indexes useful to planners and managers in assessing their air quality problems. The component models include: a model to estimate the surface temperature in complex topography; a model of the surface wind field, using surface temperature, roughness and a larger scale prevailing wind; and a model to calculate the dispersion of pollution by these winds. Author

N77-27583 Battelle Pacific Northwest Labs., Richland, Wash.
A REGIONAL SCALE MODEL FOR COMPUTING DEPOSITION AND GROUND LEVEL AIR CONCENTRATION OF SO2 AND SULFATES FROM ELEVATED AND GROUND SOURCES
L. L. Wendell, D. C. Powell, and R. L. Drake *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 429-435 refs (For primary document see N77-27569 18-45)
(Contract E(45-1)-1830)
Avail: NTIS HC A99/MF A01

A model designed to use time- and space-varying gridded wind and precipitation data, along with source locations and source strengths, to compute average air concentrations and deposited amounts of SO2 and sulfate is presented. Transport and dispersion, chemical transformation, and wet and dry removal are simulated. The sensitivity of the model results to wet removal by real time and time averaged precipitation is examined. Author

N77-27584 Washington Univ., St. Louis, Mo. Air Pollution Research Lab.
ANALYTICAL NUMERICAL MODEL FOR MESOSCALE TRANSPORT, TRANSFORMATION AND REMOVAL OF AIR POLLUTANTS
N. V. Gillani and R. B. Husar *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 437-467 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

A three-dimensional model is presented for application to isolated single plumes (point source or area source) over a mesoscale distance under well-defined and reasonably steady meteorological conditions. The model is based on eddy diffusion, the vertical component of which is considered variable with height within the daytime mixing layer. The model also includes the role of pollutant transformations, such that conversion rates are allowed to change with the age of the polluted air mass which characterizes the chemical composition. The effect of ground removal of the pollutant by dry deposition is also included. The appropriate dimensionless system parameters characterizing source elevation, plume dispersion, and pollutant transformation and ground removal are identified and their roles are discussed. The sensitivity of the model of these parameters is viewed in the light of field data of both gaseous and particulate sulfur obtained from aircraft sampling. Author

N77-27585 Washington Univ., St. Louis, Mo. Air Pollution Research Lab.
A STUDY OF LONG RANGE TRANSPORT FROM VISIBILITY OBSERVATIONS, TRAJECTORY ANALYSIS AND LOCAL AIR POLLUTION MONITORING DATA
R. B. Husar, N. V. Gillani, J. D. Husar, and D. E. Patterson *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 469-486 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

An air pollution episode over the eastern half of the U.S. which lasted nearly two weeks during June, July 1975 was studied. The method of analysis is based principally on inspection of computer plots of the national visibility data, of hand-plots of the sparser ozone and sulfate aerosol data in the eastern U.S., of synoptic weather maps, and of computed air parcel trajectories. In addition, local measurements of air pollution parameters in St. Louis and other cities are also used. Author

N77-27586 Environmental Protection Agency, Research Triangle Park, N.C. Monitoring and Data Analysis Div.
SENSITIVITY ANALYSIS OF THE SINGLE SOURCE (CRSTER) MODEL
Warren P. Freas and Russell F. Lee (NOAA, Washington, D. C.) *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 491-514 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

The sensitivity of the single source model calculated concentrations to variations in magnitude of each of the input variables related to both the source and meteorology is studied. The results of the analysis are presented in tables, input/output response graphs, and cumulative frequency distribution plots. Emphasis is placed on the maximum 24-hour concentration of SO2. It is concluded that: (1) the sensitivity of model estimates to accuracy in the input parameters varies from source to source; (2) accuracy in the source parameters becomes more critical as the stack becomes shorter; (3) errors in invididual meteorological parameters result in smaller errors in estimated concentrations than errors in source parameters; and (4) the cumulative errors in meteorological parameters can cause substantial errors in estimated concentrations. Author

N77-27587 Kappa Systems, Inc., Arlington, Va.
CONCENTRATION AND INDEX SENSITIVITY OF A GAUSSIAN PLUME MODEL

William J. Veigele and Reed L. Clayson *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 515-536 Sponsored in part by US DOT (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

An air quality model and associated pollution index used in evaluating a series of future community growth options in terms of impact on air quality are described. Advantages and disadvantages of an air quality index, applications of the model and index, and sensitivity analysis of concentrations and indexes to errors in input variables are among the topics considered. J.M.S.

N77-27588 Argonne National Lab., Ill. Energy and Environmental Systems Div.
AN AIR QUALITY DISPERSION MODEL APPLICABLE TO CALM CONDITIONS
Robert J. Yamartino, Jr. *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p537-554 refs Sponsored in part by US Air Force (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

A Gaussian puff solution to the diffusion equation is given. A closed form expression for the observed time-averaged concentration due to a steady-state source is obtained. The solution, valid for all wind speeds, is in a form compatible at finite wind speeds with the steady-state Gaussian plume formulation. The procedure for setting the dispersion parameters is described, and their values are related to existing experimentally determined quantities. Special cases of model application under calm conditions are treated and include: an approximate procedure for treating extended sources, effects of an inversion lid, line sources, and extended periods of calm. Model limitations and possible improvements are discussed. Author

N77-27589 Technische Hochschule, Darmstadt (West Germany). Inst. fuer Meteorologie.
THE ROLE OF TURBULENT DIFFUSION IN THE DIRECTION OF THE MEAN WIND IN A NUMERICAL AQSM
Klaus Herrmann *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 555-581 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

Diffusion effects in x-direction were examined for the concentration field. This is achieved by simulating the transport by advection and diffusion along the three axes x, y, and z with a numerical model and relating the results to that case, in which the x-diffusion term was not taken into account. This method can only give a first qualitative insight into the problem, because the input data of the model are wind speed and the three diffusion coefficients KX, KY, and KZ for the x, y, and z-direction. To cover the whole range of the problem, three aspects were investigated. The first gives an introduction in the qualitative role of the x-diffusion, if an advection exists. The influence of single parameters, such as wind speed, diffusion coefficients, source height, and mixing height, on the changes of the concentration field are studied. Some realistic combinations of the parameters were related from a scheme of stability classes; that gives estimations of the values for various stabilities. Author

N77-27590 Technischer Uerberwachungs-Verein Rheinland, e.V., Cologne (West Germany).
INFLUENCES OF MODEL PARAMETERS AND SENSITIVITY TO THEIR VARIATION WITHIN THE EMISSION FORECASTING
L. Kropp and H. Bresser *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 583-604 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

The influence of different diffusion parameters, effective source height, meteorologic data (requirements of accuracy), mixing and inversion height source data and their exactness, source dimension and chemical or physical processes was investigated quantitatively. The most critical influencing is given by the diffusion parameters. It can be stated that there are different sets of diffusion parameters from different experiments which lead to a consistent result, i.e., emission value calculations. Another critical parameter for air pollution modeling and forecasting is the effective source height. A slight change of this value within a certain region of height shows remarkable changes of the calculated ground level concentrations. Author

N77-27591 Environmental Protection Agency, Research Triangle Park, N.C.
DISPERSION OF ROOF-TOP EMISSIONS FROM ISOLATED BUILDINGS: A WIND TUNNEL STUDY
Roger S. Thompson (Environmental Sciences Research Lab.) and David J. Lombardi (Northrop Services, Inc., Research Triangle Park, N. C.) *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 611-627 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

A fluid modeling study of the dispersion of roof-top emissions from rectangular buildings was performed in a meteorological wind tunnel. The basic building shape was a 0.18 meter cube, but variations included buildings two times as wide and two and three times as high. Each building was placed in a 1.8 meter, simulated, neutral atmospheric boundary layer. Low momentum, nonbuoyant emissions were released through an opening at the roof center. Photographs of flow visualization experiments are provided for a qualitative evaluation of the building wakes. Concentration measurements at ground-level and aloft are presented for each case of downwind distances within 20 building heights. Concentrations are presented in a nondimensional form for ease in application to full scale situations. The orientation of the wind to the building was found to significantly affect ground-level concentrations near the building. Author

N77-27592 IBM Italia, Venezia. Scientific Center.
AN EFFICIENT AIR QUALITY K-MODEL
E. Runca *In* NATO Comm. on the Challenge of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 629-650 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

An air quality model based on the numerical integration of the time dependent tridimensional convection diffusion equation, written according to the k-theory, was developed. The finite difference scheme proposed for the integration of the model equation was based on the method of fractional steps. The convection and diffusion steps were treated with Carlson's and Crank-Nicolson's scheme respectively. This algorithm, which is unconditionally stable, showed a great flexibility. A numerical investigation on the two dimensional case describing horizontal advection and vertical diffusion of an atmospheric pollutant downwind from a line source proved that the proposed scheme, although of first order accuracy, was in practice substantially more accurate than other difference schemes of first and second order, to which it was compared. A new method was developed for computing accurately the concentration distribution close to the sources without being forced to place the source in a grid point. Author

N77-27593 Instituto di Ricerche (G. Donegani), Novara (Italy).
FURTHER DEVELOPMENTS IN THE APPLICATION OF SHIRIS MODEL TO THE VENICE AREA
G. L. Marziano, A. Sutera, L. Gianolio, and M. Ciprian *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 651-696 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

An application to the area of Venice (Italy) of the air quality simulation model is presented. Two different periods of the year (winter and summmer) were chosen for the simulation, so that different meteorological and emission situations might be considered. The model results are analyzed by comparison with experimental data. It appears that the model gives as good results in Venice as were obtained in St. Louis provided that equally accurate values of input parameters are supplied. The most critical of these parameters turned out to be the wind field, which is obtained by simplified interpolation between geostrophic and surface wind data. Author

N77-27594 Environmental Research and Technology, Inc., Concord, Mass.
A THREE-DIMENSIONAL ADVECTIVE-DIFFUSIVE MODEL FOR LONG RANGE SULFATE TRANSPORT AND TRANSFORMATION
B. A. Egan, K. S. Rao, and A. Bass *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 697-714 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

Sulfate Regional Experiment (SURE) program was proposed for further understanding of the production and dispersion of atmospheric sulfates. One aspect of a design study for SURE is examined: the development/adaptation of a numerical grid model for the calculation of SO2 and SO4(2-) over large regional scales. The modeling effort was directed toward providing guidance in the design of the field program. Data from the experimental program will be used to test a number of cause and effect hypotheses associated with sulfate air quality levels and will be used to develop a mathematical model for use in defining control strategies. Author

N77-27595 Landesanstalt fuer Immissions- und Bodennutzungsschutz, Essen (West Germany).
AN EMPIRICAL EQUATION FOR SIMULATING MAXIMUM CONCENTRATION VALUES OCCURING AT BUILDINGS PROJECTING INTO THE PATH OF A PLUME IN THE IMMEDIATE VICINITY OF AN EMISSION SOURCE
J. Giebel *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 715-725 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

The equation simulates maximum concentration values that occur at objects projecting into the path of the plume the source distance ranging from 10 to 80 m. Concentrations are expected in 2.5% of the time when the wind blows out of a sector of 45 deg from the source to the sampling point. Sampling time is 20 minutes. The results of this equation were compared to Stern formula and Gaussian type diffusion models. J.A.M.

N77-27596 Cramer (H.E.) Co., Inc., Salt Lake City, Utah.
IMPROVED TECHNIQUES FOR MODELING THE DISPERSION OF TALL STACK PLUMES
Harrison E. Cramer *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 731-780 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

A comprehensive set of generalized dispersion formulas are described for calculating the air quality impact of the plumes discharged from tall stacks located in either flat or complex terrain. The Briggs plume rise equations, with a restriction on plume rise for stack Froude numbers greater than about 3 when the mean wind speed at stack height approaches or exceeds the stack exit velocity, are used to calculate plume stabilization height, stabilization distance, and the plume diameter at stabilization. For plumes that stabilize within the surface mixing layer, an improved Gaussian plume model is used to calculate downwind lateral and vertical plume dimensions, axial and ground-level concentrations, and other dispersion parameters. The vertical term of the Gaussian model contains the vertical intensity of turbulence at plume stabilization height, a rectilinear expansion law, a virtual distance expression to adjust for the vertical plume dimension at stabilization, and multiple reflection terms that limit the plume to the surface mixing layer. Author

N77-27597 Atmospheric Environment Service, Toronto (Ontario).
PLUME DISPERSION FROM THE SUDBURY TALL STACK
F. H. Fanaki and H. E. Turner *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 781-812 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

Increasing consideration is being given to the tall stack as a technique for maintaining air quality at ground level. This, in turn, has focussed attention on the difficulties associated with the estimation of the plume rise and dispersion to be expected from such structures, in particular, the specification of appropriate plume rise formulas, stability categories, and associated plume diffusion parameters. The problem is discussed in terms of the results from a field study of plume dispersion from a 381 meter smelter stack where experimental observations are compared with simple theoretical models. Author

N77-27598 Atmospheric Environment Service, Toronto (Ontario).
A COMPARISON OF STAR STABILITY PREDICTIONS, MEASURED LAPSE-RATE STABILITY CLASSIFICATIONS AND OBSERVED TALL STACK PLUME DISPERSION PARAMETERS
R. V. Portelli *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 813-830 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

Field measurements of vertical thermal stability and tall stack plume dispersion parameters are compared with Star predictions. The observations were obtained during two field programs, June 1973 and September 1974, to investigate plume dispersion from the 381 m smelter stack of the International Nickel Company (INCO) of Canada at Sudbury, Ontario. The study utilizes the meteorological measurements (minisonde and radiosonde), photographic plume-rise observations, and aircraft plume sampling data taken during these field programs. Author

N77-27599 Atmospheric Environment Service, Downsview (Ontario).
MATHEMATICAL MODELLING OF CHEMICAL REACTIONS IN A PLUME
M. Lusis *In* NATO Comm. on the Challenges of Mod Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 831-855 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

Equations included a discrete approximation to dispersion and chemical reactions in a plume which, for inert pollutants, gives a Gaussian concentration distribution. Reactive pollutants which may be entrained from the ambient air were taken into account through the C sub B(0) terms, while chemical reactions enter through the r sub B terms. The form of the latter will depend on the type of reaction. Author

N77-27600 Johann-Wolfgang-Goethe-Universitat, Frankfurt am Main (West Germany). Inst. fuer Meteorologie und Geophysik.
ON SO2-REMOVAL AND SULFATE FORMATION PROCESSES IN THE ATMOSPHERE
D. R. Kalthoff *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 857-870 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

Chemical reactions of sulfur dioxide in the atmosphere are discussed, including both homogeneous and heterogenous gas phase oxidations. Atmospheric trace constituents absorbed by different surfaces were considered, emphasizing the dry deposition process. J.A.M.

N77-27601 NATO Committee on the Challenges of Modern Society, Brussels (Belgium).
COMPARISON BETWEEN EXPERIMENTALLY MEASURED DIFFUSION PARAMETERS AND THE MAIN STABILITY CRITERIA
L. Santomauro (Osservatorio Meteorologica di Brera, Milano, Italy), D. Anfossi (Consiglio Nazionale delle Ricerche, Torino, Italy), P. Bacci (Ente Nazionale per l'Energia Elettrica, Trino Vc., Italy), and A. Longhetto (Ente Nazionale per l'Energia Elettrica, Trino Vc., Italy) *In its* Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 876-895 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

Diffusion coefficients were experimentally determined at two different sites (a flat country, chosen in order to calibrate diffusion coefficient estimates, obtained by our experimental methodology, with classical dispersion curves, and an irregular coastal site) and compared to classical and recent dispersion estimates. Author

N77-27602 Electricite de France, Paris. Direction des Etudes et Recherches.
EXPERIMENTAL STUDY OF ATMOSPHERIC DIFFUSION PARAMETERS
A. Saab and M. Ribon *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modelling and its Appl. 1976 p 897-909 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

An effort was made to compute Lagrangian statistical parameters from fixed point data, using Eulerian time scale derived from the autocorrelation coefficient and energy dissipation rate. There were systematic differences among the Eulerian turbulence data obtained on different heights during the extreme stabilities. Effects of atmospheric stability were most clearly defined for the vertical dispersion which was essentially determined by the effects of aerodynamic friction and buoyancy in the boundary layer. Author

N77-27603 Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
MODELLING THE ATMOSPHERIC DISPERSAL OF RADIOACTIVE POLLUTANTS BEYOND THE FIRST FEW HOURS OF TRAVEL
H. M. ApSimon and A. J. H. Goddard *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 915-930 refs Sponsored in part by EURATOM (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

The application of this air pollution model in simulating the travel and dispersal of radioactive material over Europe following routine release from nuclear power installations is illustrated, along with exposure and population doses resulting from inhalation. The model considers releases of a few hours duration from any chosen site, and uses pressure fields over Europe at six hour intervals during and after release, together with quasi-geostrophic forecasting techniques. These techniques were used to track the meandering paths taken by a series of discrete puffs of radioactive material until they left the map area. Along the path of each puff, local meteorological data including cloud cover and rainfall at the time of passage were used to assess the likely state of the boundary layer. Author

N77-27604 Pennsylvania State Univ., University Park. Dept. of Meteorology.
DIFFUSION AND TRANSPORT OF A PASSIVE CONTAMINANT OVER COMPLEX TERRAIN UNDER STABLE AND UNSTABLE CONDITIONS
Richard A. Anthes, Nelson Seaman, and Daniel Keyser *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 931-947 refs (For primary document see N77-27569 18-45) (Contract EPA-800-397-03)
Avail: NTIS HC A99/MF A01

Two experiments are described which forecast the diffusion and transport of a passive contaminant in the vicinity of steep terrain on a small regional scale (horizontal domain size approximately 60 km with a horizontal resolution of 3 km). First, the wind and temperature structure in the lowest half of the atmosphere were predicted with the vertical cross section version of the Penn State mesoscale dynamic model. The forecast was made over a three hour period beginning 1 hour before sunrise. The output from this model was saved and used in a subsequent transport and diffusion model designed for use over variable terrain. The results indicate a plausible behavior of both models under stable and unstable conditions over mountainous terrain. Author

N77-27605 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphare
ON THEORETICAL METHODS FOR THE SOLUTION OF COMPLEX URBAN AIR POLLUTION PROBLEMS
H. Fortak *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 948-988 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

The concept of Green's function is generalized. In case of the most general initial and boundary value problem, for diffusion and transport within a bounded region, it is shown that Green's function that fulfills the corresponding homogeneous problem reduces the general problem to integrations only. Initial conditions are allowed to be arbitrary functions of space, sources in space and sources (or sinks) at the boundary of a closed domain may be arbitrary functions of space and time. This statement is shown to be true in case of the most general budget equation for turbulent transport and diffusion in the atmosphere. Author

N77-27606 European Atomic Energy Community, Ispra (Italy).
POLLUTANT DISPERSION SIMULATION BY MONTE CARLO TECHNIQUES
K.-H. Mueller *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 989-1012 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

Dispersion mechanisms for air pollutants are discussed. Simulation techniques are examined, including Eulerian and Lagrangian models. The continuum and particle theories are considered, along with chemical reactions. Various properties of eddy diffusion are reviewed, such as life time, equilibrium, thermalization, buoyancy, and boundary conditions. J.A.M.

N77-27607 NATO Committee on the Challenges of Modern Society, Brussels (Belgium).
MATHEMATICAL MODEL FOR URBAN DIFFUSION OF CARBON MONOXIDE FROM MOTOR VEHICLES
P. P. Gaddo (FEEMAS/Fiat), F. Corazzari (FEEMAS/Fiat), R. Borgialli (FEEMAS/Fiat), G. Marcenaro (FEEMAS/ESSO), G. Marchesi (FEEMAS/ENI), F. Carbone (FEEMAS/Mobil), G. Ferrante (FEEMAS/Mobil), D. Casella (FEEMAS/Alfa Romeo), A. Piccone (FEEMAS/Alfa Romeo), S. Chiaiso (FEEMAS/Shell) et al *In its* Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 1013-1030 (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

The model input data (traffic hourly distribution and its qualitative and quantitative composition, specific emissions, meteorological parameters) were obtained through surveys and experimental determinations. Hence, they represent the true urban area conditions referred to town arterial plan, traffic, and meteorological conditions. The output data were checked on the base of CO concentration levels observed at the monitoring station of the FIAT network. The model proved suitable to simulate the pollution levels induced by motorized traffic in a town like Turin: namely, the trends of calculated and observed levels are quite similar. Author

N77-27608 Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy).
SOME CONSIDERATIONS ABOUT THE STABILITY CATEGORIES IN THE CASE OF SHORT RANGE DIFFUSION OF ATMOSPHERIC RELEASES
Pietro Cagnetti *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 1037-1058 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

A series of about 30 atmospheric diffusion experiments using a chemical tracer was carried out to study the effect of the turbulence induced by buildings of a nuclear research center on the diffusion of contaminants over short distances. It is pointed out that, on a wide range of stability situations practically analyzed, the results do not confirm the variety of estimates generally suggested for flat terrain by literature. Some practical rules are given to evaluate the dilution of contaminants over short distances at the Casaccia Nuclear Research Center site for situations ranging from instability to light stability. Author

N77-27609 Atmospheric Environment Service, Toronto (Ontario).
APPLICATION OF THE TENNEKES-CARSON SLAB MODEL OF THE PBL TO THE PREDICTION OF INTERNAL BOUNDARY LAYER DEVELOPMENT
A. Venkatram *In* NATO Comm. on the Challenges of Mod.

Soc. Proc. of the 7th Intern. Tech. Meeting on Air Pollution Modeling and its Appl. 1976 p 1059-1073 refs (For primary document see N77-27569 18-45)
Avail: NTIS HC A99/MF A01

A physically realistic model of internal boundary layer development is suggested by using mixed layer model in a Lagrangian framework. One advantage of such an approach is presented. A computationally simple advective mixed layer model which in some ways is similar to the successful urban boundary layer model. Author

N77-27610# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
RESONANCE ABSORPTION LINESHAPE OF NO USING A ZEEMAN TUNED Cd LAMP: APPLICATION TO COMBUSTION
T. Hadeishi, Y. Agrawal, R. D. McLaughlin, and F. Robben 6 Jan. 1976 7 p refs
(Contract W-7405-eng-48)
(LBL-5213) Avail: NTIS HC A02/MF A01

Absorption lineshape and effective collision broadening cross-section for excitation of a single line corresponding to the lambda 2 mu K - 13 transition of the 01 vibrational band of NO, using Zeeman scanning of the 2144.38 A CdII line were measured. Some uncalibrated measurements under combustion conditions have also been made. ERA

N77-27611# Stanford Univ., Calif.
CORRELATION IN CONDITIONAL DISTRIBUTIONS: SOME SUGGESTIONS FOR MEASURING THE RELATIONSHIPS BETWEEN TWO SETS OF POLLUTANTS WHEN THE EFFECT OF WEATHER HAS BEEN REMOVED
June Juritz 11 Oct. 1976 12 p refs
(Contract EY-76-S-02-2874)
(COO-2874-7) Avail: NTIS HC A02/MF A01

Some multivariate statistical tests are reviewed that could be used to measure relationships between two sets of measurements on air pollutants when both sets are affected by the weather. The tests are easily carried out using standard statistical packages, and the results may be used to indicate whether it is worthwhile to proceed or to develop more delicate procedures. ERA

N77-27612# Argonne National Lab., Ill.
DETERMINING BIOLOGICAL SIGNIFICANCE OF ENVIRONMENTAL IMPACTS: SCIENCE OR TRANS-SCIENCE
Rajendra K. Sharma 1975 9 p Presented at the Workshop on the Biol. Significance of Environ. Impacts, Ann Arbor, Mich., 4 Jun. 1975
(Contract W-31-109-eng-38)
(CONF-750646-4) Avail: NTIS HC A02/MF A01

Determination of the significance of environmental impacts is discussed in the context of statistical, biological, and socioeconomic perspectives and in the context of organism, population, and community levels. An approach, based on the concept of maximum sustained yield, is advanced for the allocation of living natural resources to accommodate environmental impacts. Concepts of environmental impact studies are examined in the light of baseline and post-impact study programs, natural variability in ecosystems, selection of study parameters, and geographical extent of the study. ERA

N77-27613# Mitre Corp., McLean, Va. METREK Div.
PRELIMINARY SCORING OF SELECTED ORGANIC AIR POLLUTANTS
B. Fuller, J. Hushon, M. Kornreich, R. Quellette, L. Thomas, and P. Walker Oct. 1976 114 p refs 5 Vol.
(Contract EPA-68-02-1495)
(PB-264442/5; EPA-450/3-77-008a) Avail: NTIS HC A06/MF A01; also available in set of 5 reports PC E17, PB-264441-SET CSCL 06T

A scheme is presented for evaluating the relative hazard to humans resulting from air emissions of synthetic organic chemicals. Data on production, fraction lost during production, volatility, and toxicity were compiled for 637 organic chemicals. Numerical scores were then assigned based on these data. GRA

N77-27614# Mitre Corp., McLean, Va. METREK Div.
PRELIMINARY SCORING OF SELECTED ORGANIC AIR POLLUTANTS. APPENDIX 1: CHEMISTRY, PRODUCTION, AND TOXICITY OF CHEMICALS A THROUGH C
J. Dorigan, B. Fuller, and R. Duffy Oct. 1976 330 p 5 Vol.
(Contract EPA-68-02-1495)
(PB-264443/3; EPA-450/3-77-008-App-1) Avail: NTIS HC A11/MF A01; also available in set of 5 reports PC E17, PB-264441-SET CSCL 06T

Available data on chemical structure and properties, environmental persistence, production, and toxicity for 637 synthetic organic chemicals are presented. For vol. 1, see N77-27613. The chemicals acenaphthene through cyprex are covered. GRA

N77-27615# Mitre Corp., McLean, Va. METREK Div.
PRELIMINARY SCORING OF SELECTED ORGANIC AIR POLLUTANTS. APPENDIX 2: CHEMISTRY, PRODUCTION, AND TOXICITY OF CHEMICALS D THROUGH E
J. Dorigan, B. Fuller, and R. Duffy Oct. 1976 336 p 5 Vol.
(Contract EPA-68-02-1495)
(PB-264444/1; EPA-450/3-77-008-App-2) Avail: NTIS HC A15/MF A01; also available in set of 5 reports PC E17, PB-264441-SET CSCL 06T

The chemicals dacthal through ethyl silicate are covered. For vol. 1, see N77-27613. GRA

N77-27616# Mitre Corp., McLean, Va. METREK Div.
PRELIMINARY SCORING OF SELECTED ORGANIC AIR POLLUTANTS. APPENDIX 3: CHEMISTRY, PRODUCTION, AND TOXICITY OF CHEMICALS F THROUGH N
J. Dorigan, B. Fuller, and R. Duffy Oct. 1976 312 p
(Contract EPA-68-02-1495)
(PB-264445/8; EPA-450/3-77-008D-App-3) Avail: NTIS HC A14/MF A01 CSCL 06T

The entire appendix contains a compilation of available data on chemical structure and properties, environmental persistence, production, and toxicity for 637 synthetic organic chemicals. This third volume covers the chemicals ferbam through nonyl phenol. GRA

N77-27617# Mitre Corp., McLean, Va. METREK Div.
PRELIMINARY SCORING OF SELECTED ORGANIC AIR POLLUTANTS. APPENDIX 4: CHEMISTRY, PRODUCTION, AND TOXICITY OF CHEMICALS O THROUGH Z
J. Dorigan, B. Fuller, and R. Duffy Oct. 1976 333 p
(Contract EPA-68-02-1495)
(PB-264446/6; EPA-450/3-77-008E-App-4) Avail: NTIS HC A15/MF A01 CSCL 06T

This is the fourth of a series of four appendices to the report 'Scoring of Organic Air Pollutants.' The entire appendix contains a compilation of available data on chemical structure and properties, environmental persistence, production, and toxicity for 637 synthetic organic chemicals. This fourth volume covers the chemicals octyl alcohol through zinc stearate. Also it contains a chemical name index. GRA

N77-27618# Environmental Protection Agency, Washington, D. C. Office of Research and Development.
ENVIRONMENTAL RESEARCH OUTLOOK FOR FY 1977 THROUGH FY 1981: REPORT TO CONGRESS
Feb. 1977 196 p
(PB-264529/9; EPA-600/9-77-002) Avail: NTIS HC A09/MF A01 CSCL 13B

The general role of environmental research is discussed. Anticipated research over the next five years is discussed for each of the fourteen subprograms, as well as for six current interest modules which cut across several of the subprograms. The dominant programs in the forecast period are health effects studies and energy-related comprehensive environmental research. Impacts of level and increasing budgets on scheduling of program outputs are also discussed. GRA

N77-27619# Illinois Inst. for Environmental Quality, Chicago.
LAND POLLUTION: STRATEGIES FOR EMERGENCY ACTION Final Report
Oct. 1976 204 p refs Prepared in Cooperation with Illinois State Geological Survey, Urbana
(PB-264644/6; IIEQ-76-20) Avail: NTIS HC A10/MF A01 CSCL 13B

Case histories of 116 land and ground-water contamination incidents and the programs that were developed to restore land and groundwater quality were documented from the literature and summarized. GRA

N77-27620# Wapora, Inc., Washington, D. C.
ASSESSMENT OF INDUSTRIAL HAZARDOUS WASTE PRACTICES: ELECTRONIC COMPONENTS MANUFACTURING INDUSTRY Final Report, Oct. 1975 - Jan. 1977
Gerald O. Peters, James Levin, and Peter Thomas Jan. 1977 207 p refs
(Contract EPA-68-01-3193)
(PB-265532/2; EPA/SW-140C) Avail: NTIS HC A10/MF A01 CSCL 09C

Based upon the plant survey data, land-disposed wastes of the industry fall into ten waste categories including five categories which are both land-disposed in quantifiable amounts and contain hazardous materials (halogenated solvents, non-halogenated solvents, wastewater treatment sludges, painting wastes, and hydraulic and lubricating oils), and five categories which included either unquantifiable amounts of hazardous materials, no hazardous materials or were not typically land-filled (metal scrap, concentrated cyanides, concentrated acids and alkalies, plastic wastes, and miscellaneous). Isolated occurrences of beryllium- and PCB-containing wastes were recognized. GRA

N77-27621# Colorado Univ., Boulder. Dept. of Civil and Environmental Engineering.
POLLUTIONAL CHARACTERISTICS OF URBAN SNOWMELT RUNOFF M.S. Thesis
George M. Battaglia Dec. 1976 134 p refs
(Contract DI-14-34-0001-6006; OWRT Proj. A-028-COLO(1))
(PB-264715/4; W77-05370) Avail: NTIS HC A07/MF A01 CSCL 13B

The recorded snowfalls and subsequent runoff have been investigated for the fall and winter. Concentrations of urban stormwater runoff, pollutant variations in Boulder Creek, and loadings from the storm sewer were also evaluated during this period. While adding only 13.5% of the total flow to the creek, the storm sewer contributes almost 50% of the total solids and lead, and over 75% of the suspended solids. GRA

N77-27622# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Medical and Biologic Effects of Environmental Pollutants.
NITROGEN OXIDES
Feb. 1977 503 p refs
(Contract EPA-68-02-1226)
(PB-264872/3; EPA-600/1-77-013) Avail: NTIS HC A22/MF A01 CSCL 04B

The environmental health basis for control of manmade sources of nitrogen oxide emissions is reviewed. The literature review covered the period through 1974. The principal subject areas considered include: sources and control of atmospheric nitrogen oxides; analytical methodology; concentrations and chemical reactions in the atmosphere; and the effects of nitrogen oxides on human health, materials, vegetation, light transmission, and natural ecosystems. Emphasis is primarily on nitric oxide and nitrogen dioxide. The major manmade source is the combustion of fossil fuel. Highest atmospheric concentrations are found in heavily populated, industrialized urban areas. Both acute and chronic health effects resulting from short term and long term exposures are discussed. Effects range from slight increases in airway resistance to death, depending upon exposure concentrations. GRA

N77-27623# Fluidyne Engineering Corp., Minneapolis, Minn.
EFFECTIVE SAMPLING TECHNIQUES FOR PARTICULATE EMISSIONS FROM ATYPICAL STATIONARY SOURCES Interim Report, Jun. 1975 - Sep. 1976
H. A. Hanson and D. P. Saari Feb. 1977 131 p refs
(Grant EPA-68-02-1796)
(PB-264893/9; EPA-600/2-77-036) Avail: NTIS HC A07/MF A01 CSCL 13B

Low effluent streams, extended dimensions, partially or totally unconfined flow and saturated gas streams or gas streams with entrained liquid droplets were investigated. Literature surveys, laboratory model testing, and field testing of several atypical stationary sources were conducted. Sampling techniques and instruments were evaluated as to the degree of reliability of measured emissions and applicability to general situations. Gravity roof ventilators, grain dryers, and wet scrubbers were studied. Basic characteristics of these sources were identified through literature and personal surveys. A program of model testing and field testing of roof ventilator emissions was completed, and a similar program was undertaken for wet scrubbers. The sampling strategy recommended for roof ventilator emission measurement includes a high volume particulate sampler and a heated thermopile anemometer deployed near the base of the ventilator. GRA

N77-27624# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
NATIONAL TRENDS IN TRACE METALS IN AMBIENT AIR, 1965-1974
Robert B. Faoro and Thomas B. McMullen Feb. 1977 41 p refs
(PB-264906/9; EPA-450/1-77-003) Avail: NTIS HC A03/MF A01 CSCL 13B

The trends over 10 years in ambient concentrations for 11 metals are examined: beryllium, cadmium, chromium, copper, cobalt, iron, lead, manganese, nickel, titanium, and vanadium. The trends are derived from samples collected from 92 urban and 16 nonurban hi-vol stations in the National Air Surveillance Network. For purposes of presentation, the trace metals were grouped into two broad categories: the metals related to fuel combustion and those related to industry. Possible reasons for the trends observed are given for most of the metals studied. GRA

N77-27625# Environmental Protection Agency, Washington, D. C. Office of the Administrator.
REPORT OF THE HEARING PANEL: NATIONAL PUBLIC HEARING ON POWER PLANT COMPLIANCE WITH SULFUR OXIDE AIR POLLUTION REGULATIONS
Jan. 1974 108 p refs Conf. held at Washington, D. C., 18 Oct. - 2 Nov. 1973
(PB-264891/3) Avail: NTIS HC A06/MF A01 CSCL 07A

Contents: summary and recommendations; background; utility compliance efforts; status of flue gas desulfurization technology (lime/limestone FGD technology, Wellman-Lord sodium-based scrubbing, technology summary); vendor guarantees; flue gas desulfurization system malfunctions; waste disposal; costs of flue gas desulfurization systems; time requirements for installation of flue gas desulfurization systems; and capacity of vendors to install flue gas desulfurization systems. GRA

N77-27626# Consumer Product Safety Commission, Washington, D.C. Bureau of Biomedical Science.
DETERGENT SURVEY TOXICITY TESTING (1971-1976)
Van M. Seabaugh, Steven P. Bayard, Robert E. Osterberg, Warren K. Porter, and Donald F. McCaulley 18 Mar. 1977 42 p refs
(PB-264698/2) Avail: NTIS HC A03/MF A01 CSCL 06T

These studies showed that toxicological results cannot always be predicted or explained on the basis of physical or chemical data. No clear-cut relationships were seen between the biological tests. All of the tested detergents were eye irritants. Eighty-one percent were either esophageal test irritants or corrosives, and 80% had oral toxicities 5 g/kg or less. Forty-seven percent were also either primary skin irritants or corrosive. GRA

N77-27627# Battelle Columbus Labs., Ohio.
THE SOURCES AND BEHAVIOR OF HEAVY METALS IN WASTEWATER AND SLUDGES Final Report
B. W. Vigon, R. A. Craig, and N. A. Frazier Mar. 1977 63 p refs
(Contract EPA-68-03-1177)
(PB-265006/7; EPA-600/2-77-070) Avail: NTIS HC A04/MF A01 CSCL 13B

A critical evaluation has been made of the literature regarding the sources of heavy metals in sludges from municipal wastewater treatment plants. Residential loadings of heavy metals as a percentage of total metal loads are highly variable with respect to both the particular element under consideration and the

geographic area. Only rarely is the percentage contribution of any metal attributable to residential sources greater than one-half the total. GRA

N77-27628# Atlantic Research Corp., Alexandria, Va.
EVALUATION OF METHODOLOGY AND PROTOTYPE TO MEASURE ATMOSPHERIC SULFURIC ACID Final Report
R. E. Snyder, T. J. Reed, and A. M. McKissick Jan. 1977 96 p refs
(Contract EPA-68-02-2247)
(PB-265395/4; ARC-49-5664; EPA-600/2-77-010) Avail: NTIS HC A05/MF A01 CSCL 07D

A method to selectively assay ambient sulfuric acid aerosol is reviewed. The method utilizes the vapor of a volatile amine (or amine derivative) to neutralize the acid as it is collected on a Teflon filter. The amine sulfate formed is thermally decomposed at 200 C to release sulfur dioxide, or other stoichiometrically related sulfur containing adduct, which is measured by a flame photometric detector. Immediate chemical fixation of the acid lessens the chance of side reactions with other substances on the filter, while the relatively low decomposition temperature eliminates particulate interferences such as ammonium sulfate GRA

N77-27629# Stanley (William J.) and Associates, Inc., Chicago, Ill.
ECONOMIC FEASIBILITY OF ENFORCING RULE 206(C) CARBON MONOXIDE LIMITATIONS ON ILLINOIS FIRMS USING PARTIAL OXIDATION PROCESSES Final Report
William J. Stanley, James E. Ciecka, and Anthony C. Petto Dec. 1976 143 p refs Sponsored by Ill. Inst. for Environ. Quality (PB-264645/3; IIEQ-76-28) Avail: NTIS HC A07/MF A01 CSCL 07A

The economic feasibility of compliance with Rule 206(c) of the Illinois Air Pollution Regulations for four Illinois chemical firms that use partial oxidation processes in the manufacture of polybasic acids and their anhydrides (such as maleic anhydride, phthalic anhydride, terephthalic acid, isophthalic acid and trimellitic anhydride) is analyzed. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

N77-27630 Princeton Univ., N. J.
MANTLE HETEROGENEITY: EVIDENCE FROM LARGE SEISMIC ARRAYS Ph.D. Thesis
Christine Ann Powell 1976 340 p
Avail: Univ. Microfilms Order No. 77-2160

The presence of heterogeneity within the earth's mantle was detected using observations from four large seismic arrays located in the western United States. A large array provides a direct measurement of the wave slowness (dT/d delta) and azimuth of approach for incoming teleseismic body waves. Measurements made at each array were plotted in the form of mislocation vectors in an array diagram. After appropriate crustal corrections were made, array diagrams for three of the arrays used, LASA, TFSO, and a USGS array located near Hanford, Washington, were similar to each other in appearance. This suggests that the heterogeneities responsible for the mislocations are located at considerable distance from the arrays, either in the vicinity of the source regions or in the lower mantle. Dissert. Abstr.

N77-27631 California Univ., San Diego.
EXPERIMENTAL AND NUMERICAL THREE-DIMENSIONAL SIMULATIONS OF STRIKE-SLIP EARTHQUAKES Ph.D. Thesis
Ralph Joseph Archuleta 1976 144 p
Avail: Univ. Microfilms Order No. 77-4202

Strike-slip earthquakes were simulated experimentally and numerically to evaluate earthquake-caused near field ground motion. For the experimental simulations, semicircular, elliptical, and rectangular cuts were made in three blocks of foam rubber to represent geometrically different faults in a homogeneous, isotropic, linear elastic medium. A stress field appropriate for a strike-slip earthquake was created, and displacement time functions were measured in the near field. For the numerical simulation, a finite element was used to simulate five stike-slip earthquakes occurring on vertical, semicircular fault planes which intersect the free surface of a homogeneous, isotropic, linearly elastic medium. The numerical model requires specifying a rupture velocity, an effective stress, and a final fault shape. Dissert. Abstr.

N77-27632 Ohio State Univ., Columbus.
MONITORING OF CRUSTAL MOVEMENTS IN THE SAN ANDREAS FAULT ZONE BY A SATELLITE-BORNE RANGING SYSTEM Ph.D. Thesis
Muneendra Kumar 1976 152 p
Avail: Univ. Microfilms Order No. 77-2439

The Close Grid Geodynamic Measurement System is conceived as an orbiting ranging device with a ground base grid of reflectors or transponders (spacing 1.0 to 30km), which are projected to be of low cost (maintenance free and unattended), and which will permit the saturation of a local area to obtain data useful to monitor crustal movements in the San Andreas fault zone. A station network of 75 stations covering an area between 36 deg N and 38 deg N latitudes, and 237 deg E and 239 deg E longitudes is envisioned, with roughly half of the stations on either side of the faults. Laser radar is considered to be the main ranging system pending final selection from many possible candidates. Geometric and short arc modes are the two main methods for handling ranges and solution/adjustment of the system. Dissert. Abstr.

N77-27633 California Univ., Los Angeles.
STATISTICAL PROPERTIES OF Pc 3 AND Pi 1 MAGNETIC PULSATIONS OBSERVED AT SYNCHRONOUS ORBIT AND IN THE AURORAL ZONE Ph.D. Thesis
Carlene Wynne Arthur 1976 191 p
Avail: Univ. Microfilms Order No. 77-1610

A statistical study of 420 Pc 3 magnetic pulsation events observed at the synchronous satellite indicates that Pc 3 events are a common occurrence at ATS 6 during local morning with a peak occurrence near 1000 LT. The dominant period is approximately 30 sec, and the waves are linearly polarized and generally transverse to the magnetic field. Based on azimuth angle, there are two classes of waves with different characteristics: azimuthal, which comprise the main portion of the dominant frequency observations, show a local time-frequency dependence (with higher frequencies occurring near noon), are linear and very transverse, and show a varation of azimuth with local time; radial, mainly occur at frequencies higher than .03 Hz, show no variation of frequency with local time, are linear but often have a significant compressional component, and show a variation of azimuth with local time. Dissert. Abstr.

N77-27634 Wisconsin Univ., Madison.
ALMOST TRAPPED SURFACE GRAVITY WATER WAVES AROUND ISLANDS Ph.D. Thesis
Carlos Jose Lozano 1976 118 p
Avail: Univ. Microfilms Order No. 76-25569

A model for linear surface gravity waves in waters with variable depth was developed. A rigorous theory based on this model on almost trapped surface waves in islands with a shore and cylindrical symmetry indicates that substantial but highly selective resonances do occur. The theory provides estimates for the complex valued eigenfrequencies with exponentially small precision. Dissert. Abstr.

N77-27635 Kansas Univ., Lawrence.
GEOGRAPHIC ANALYSIS OF VARIATION ACROSS A SOIL BOUNDARY AND WITHIN SOIL MAPPING UNITS Ph.D. Thesis
James Batchelder Campbell, Jr. 1976 267 p
Avail: Univ. Microfilms Order No. 77-2200

An 18 x 40 gridded sampling array was positioned over the boundary between two contrasting soil series: the Ladysmith silty clay loam, a spatially uniform soil formed from fine-textured sediments, and the Pawnee clay loam, a more variable, and coarser textured soil formed from glacial till. The B2 horizons of

both soils were sampled, and the 737 samples were analyzed for gravel, sand, and silt content, for pH, and for Munsell color (hue, value, and chroma). Dissert. Abstr.

N77-27636 Catholic Univ. of America, Washington, D. C.
INTERPRETATION OF AEROMAGNETIC ANOMALIES BETWEEN LATITUDES 37 DEG N AND 38 DEG N IN THE EASTERN AND CENTRAL UNITED STATES Ph.D. Thesis
Isidore Zietz 1976 76 p
Avail: Univ. Microfilms Order No. 77-3704

An aeromagnetic map across the eastern and central United States between latitudes 37 deg N and 38 deg N reflects the regional structure and lithology of the magnetic crystalline rocks. The major crustal units that are delineated are the Appalachian Mountain system, the buried southwesterly extension of the Grenville province, the prominent fault zones across Kentucky, southern Illinois, and Missouri, the igneous rocks of the St. Francois Mountains and vicinity, and the buried belt of lowgrade metamorphic rocks in southeastern Kansas. The map also reveals a series of conspicuous, essentially east-trending magnetic lineaments, anomaly trends, and breaks in anomaly pattern along the entire survey area. Dissert. Abstr.

N77-27637 Texas A&M Univ., College Station.
ACCURATE RMS VELOCITY DETERMINATIONS FROM CGP DATA BY MEASURING RESIDUAL NMO WITH AN ADAPTIVE METHOD Ph.D. Thesis
Sung Jin Yang 1976 197 p
Avail: Univ. Microfilms Order No. 77-2684

Two techniques of RMS root-mean-square/velocity determination were developed: one of the two is a velocity-spectra method which generates the velocity spectra efficiently and the other is an adaptive method which determines the RMS velocities very accurately. The efficient velocity-spectra method generates the velocity spectra so that the RMS velocities can be determined more accurately for shallow layers which have smaller t sub zero and V bar values than deep layers. The accuracy of the velocity determination using the adaptive method is tested for synthetic CGP gathers with various signal-to-noise (S/N) ratios. Accurate RMS velocities are determined for S/N ratios higher than 4. The accuracy decreases as the S/N ratio is lowered. The RMS velocity determined from CGP data taken in the Gulf of Mexico of Galveston are used as an example of the practical application of the above studies to actual field data.
Dissert. Abstr.

N77-27638 Tennessee Univ., Knoxville.
THE MECHANICS OF ATMOSPHERIC SYSTEMS DERIVED THROUGH VERTICAL AND HORIZONTAL ANALYSIS OF PARAMETRIC DATA Ph.D. Thesis
Robert Eugene Turner 1976 354 p
Avail: Univ. Microfilms Order No. 77-3692

Various flow diagrams of the data processing procedures are described, and a complete summary of the formulas used in the data processing are provided. A wind computation scheme designed to extract as much detailed wind information as possible from the unique experiment data set is discussed in detail. Estimates of the accuracy of the thermodynamic and wind data are presented. Estimates of errors in the thermodynamic and wind data are given with a discussion of how these errors affect the final processed data. Dissert. Abstr.

N77-27639 Pittsburgh Univ., Pa.
DRIFT-MOBILITY TUBE-MASS SPECTROMETRIC MEASUREMENTS OF ION-MOLECULE REACTION RATES OF ATMOSPHERIC INTEREST Ph.D. Thesis
Harold Lewis Brown, Jr. 1976 124 p
Avail: Univ. Microfilms Order No. 77-2992

Ion mobilities are reported for O(-) in He, NO(+) in N2, NO(+) in H2O, O(+) in He, and O2(+) in He. Construction details are given for the instrument which consisted of an electron impact source separated from the drift-mobility tube by a differentially pumped region, the drift-mobility region itself, and a quadrupole mass spectrometer. An expression is derived which describes the combined effects drift, diffusion, and reaction have on the sampled ion current. Dissert. Abstr.

N77-27640 Wisconsin Univ., Madison.
THE DIURNAL VARIATION IN RADON FLUX FROM THE SOIL DUE TO ATMOSPHERIC PRESSURE CHANGE AND TURBULENCE Ph.D. Thesis
Marian Pearl Duwe 1976 107 p
Avail: Univ. Microfilms Order No. 76-25555

The surface pressure fluctuations produced by atmospheric turbulence are parameterized as a function of wind speed and generate soil air velocities which are associated with an increase in the effective diffusion coefficient in the soil. The effective diffusion coefficient has a maximum at the time of maximum wind speed and generates a maximum in the radon flux slightly after the time of maximum wind speed with an amplitude of 25 percent of the mean radon flux for highly permeable soils.
Dissert. Abstr.

N77-27641 Princeton Univ., N. J.
THE TROPOSPHERIC LAPSE RATE AND CLIMATIC SENSITIVITY Ph.D. Thesis
Isaac Meyer Held 1976 230 p
Avail: Univ. Microfilms Order No. 77-2148

Sensitivity experiments are performed with and without a moist convective adjustment and with and without surface albedo feedback in order to examine the behavior of the model's baroclinic eddies in different environments. The experiments with albedo feedback, besides reinforcing some of the conclusions based on simpler versions of the model, predict a sensitivity of the icecap boundary to the value of the solar constant qualitatively different from that predicted by most diffusive energy balance climate models. Dissert. Abstr.

N77-27642 Tennessee Univ., Knoxville.
THREE VELOCITY COMPONENT, NONHOMOGENEOUS ATMOSPHERE BOUNDARY LAYER TURBULENCE MODELING Ph.D. Thesis
Morris Perlmutter 1976 104 p
Avail: Univ. Microfilms Order No. 77-3674

A method of simulating the atmospheric turbulent winds by filtering Gaussian white noise signals and thereby generating signals that have the same second moment statistics as the atmospheric winds is presented. The governing equations are developed for the two level autospectrum for the turbulent wind components. A control system is modeled whereby white Gaussian noise signals can be filtered, thereby generating signals with the same two level autospectra as the turbulent winds. An example calculation using the Dryden Autospectrum, an exponential coherence and a linear phase angle is illustrated, and a computer code for the computation of the random signals is provided. The method is extended to include the two level cross-spectrum between orthogonal components as well, and the appropriate filters are developed Dissert. Abstr.

N77-27643 Colorado Univ., Boulder.
PHYSICAL MECHANISMS RESPONSIBLE FOR THE MAJOR SYNOPTIC SYSTEMS IN THE EASTERN CANADIAN ARCTIC IN THE WINTER AND SUMMER OF 1973 Ph.D. Thesis
Ellsworth Frank LeDrew 1976 217 p
Avail: Univ. Microfilms Order No. 77-3197

For the winter and summer seasons the major synoptic systems in the area are identified by pattern (eigenvector) classification of the 85 centibar total vertical velocity field. For each synoptic feature the average physical processes responsible for the vertical circulation are determined by empirical comparison of patterns in each component field with the pattern of the synoptic feature, and by comparison of magnitudes of the total and component vertical velocities at the center of the feature throughout time. The physical linkages proposed by considerations of these two independent tests are verified by subjective analysis of individual cases. Seasonal trends of these mechanistic linkages are also discussed. Dissert. Abstr.

N77-27644 California Univ., Los Angeles.
A NUMERICAL SIMULATION OF THE GENERAL CIRCULATION OF ATMOSPHERIC OZONE Ph.D. Thesis
Michael Earl Schlesinger 1976 404 p
Avail: Univ. Microfilms Order No. 77-1661

The simulated synoptic distributions of total ozone show

that, in agreement with the observations, the total ozone maxima and minima in the middle latitudes of both hemispheres coincide respectively with the trough and ridge lines of the eastward-moving baroclinic waves at 500 mb. The time averaged total ozone distribution shows a similar correspondence with the 500 mb stationary waves in middle latitudes, however, both the simulated total ozone and 500 mb geopotential height fields do not display the wavenumber three component which is observed in the northern hemisphere middle latitudes. The time series of the global photochemical production rate of ozone displays a diurnal oscillation. The time series of the global surface destruction rate of ozone and the global-mean total ozone display an exponential asymptotic shape with equilibrium values which are estimated as 26 tons/sec and 274 Dobson units, respectively.
Dissert. Abstr.

N77-27645*# Kanner (Leo) Associates, Redwood City, Calif.
NATURAL SYSTEM OF EOLIAN LANDFORMS
L. Kadar Washington NASA Jun. 1977 51 p refs Transl. into ENGLISH from Foeldrajzi Ertesitoe (Hungary), v. 15, no. 4, 1966 p 413-448
(Contract NASw-2790)
(NASA-TT-F-17436) Avail: NTIS HC A04/MF A01 CSCL 08G

On the basis of the natural system of exogenic landforms, it is possible to arrange genetically all known eolian landforms, taking into account the system of fluvial landforms and the results of investigations on blown sands of R. A. Bagnold. The framework of this system consists of types of sediment transport and the stages of earth surface development. Both of the above factors depend on the size of the sand grains and on the velocity of the wind. Each composite symbol, made up of surface development and sand transport factors, indicates an association of forms from elementary phenomena such as ripple marks or smooth bottom to big oasis basins excavated by deflation and various dune forms of sand seas. Their relationship to grain size and wind velocity is shown.
Author

N77-27646*# National Oceanic and Atmospheric Administration, Rockville, Md.
US STANDARD ATMOSPHERE, 1976
Oct. 1976 241 p refs Sponsored in part by US Air Force
(NASA-CR-153748; AD-A035728) Avail: NTIS MF A01; SOD HC $6.20 CSCL 04A

The U.S. Standard Atmosphere, 1976, which is a revision of the U.S. Standard Atmosphere, 1962, was generated under the impetus of increased knowledge of the upper atmosphere obtained over the past solar cycle. Above 50 km, this Standard is based on extensive new rocket data and theory for the mesosphere and lower thermosphere, and on the vast resources of satellite data for the thermosphere acquired over more than one complete solar cycle. This Standard is identical with the ICAO Standard 1964 up to 32 km and the ISO Standard 1973 to 50 km. Part 1 gives the basis for computation of the main tables of atmospheric properties, including values of physical constants, conversion factors, and definitions of derived properties. Part 2 describes the model and data used up to 85 km, in the first section and the model and data used above 85 km, in the second section. The theoretical basis of the high-altitude model is given in an appendix. Part 3 contains information on minor constituents in the troposphere, stratosphere, and mesosphere. The main tables of atmospheric properties to 1,000 km are given in Part 4. The international system of metric units is used.
Author (GRA)

N77-27647*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GRAVITATIONAL POTENTIAL ENERGY OF THE EARTH: A SPHERICAL HARMONIC APPROACH
David Parry Rubincam Mar. 1977 30 p refs Submitted for publication
(NASA-TM-X-71346; X-921-77-81) Avail: NTIS HC A03/MF A01 CSCL 08N

A spherical harmonic equation for the gravitational potential energy of the earth is derived for an arbitrary density distribution by conceptually bringing in mass-elements from infinity and building up the earth shell upon spherical shell. The zeroth degree term in the spherical harmonic equation agrees with the usual expression for the energy of a radial density distribution. The second degree terms give a maximum nonhydrostatic energy in the mantle and crust of -2.77 x 10 to the twenty-ninth power ergs, an order of magnitude. If the earth is assumed to be a homogeneous viscous oblate spheroid relaxing to an equilibrium shape, then a lower limit to the mantle viscosity of 1.3 x 10 to the twentieth power poises is found by assuming the total geothermal flux is due to viscous dissipation. If the nonequilibrium figure is dynamically maintained by the earth acting as a heat engine at one per cent efficiency, then the viscosity is ten to the twenty second power poises, a number preferred by some as the viscosity of the mantle.
Author

N77-27648*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTROSTATIC EMISSIONS BETWEEN ELECTRON GYROHARMONICS IN THE OUTER MAGNETOSPHERE
Richard F. Hubbard and Thomas J. Birmingham May 1977 67 p refs Submitted for publication
(NASA-TM-X-71349; X-602-77-112) Avail: NTIS HC A04/MF A01 CSCL 04A

A scheme was constructed and a theoretical model was developed to classify electrostatic emissions. All of the emissions appear to be generated by the same basic mechanism: an unstable electron plasma distribution consisting of cold electrons (less than 100 eV) and hot loss cone electrons (about 1 keV). Each emission class is associated with a particular range of model parameters; the wide band electric field data can thus be used to infer the density and temperature of the cold plasma component. The model predicts that gyroharmonic emissions near the plasma frequency require large cold plasma densities.
Author

N77-27649*# Purdue Univ., Lafayette, Ind. Dept. of Geosciences.
UTILITY OF CORRELATION TECHNIQUES IN GRAVITY AND MAGNETIC INTERPRETATION Final Report, Nov. 1975 - Jan. 1977
Val W. Chandler, John S. Koski, Lawrence W. Braice, and William J. Hinze Feb. 1977 122 p refs
(Contract NAS5-22818)
(NASA-CR-152550) Avail: NTIS HC A06/MF A01 CSCL 08N

Internal correspondence uses Poisson's Theorem in a moving-window linear regression analysis between the anomalous first vertical derivative of gravity and total magnetic field reduced to the pole. The regression parameters provide critical information on source characteristics. The correlation coefficient indicates the strength of the relation between magnetics and gravity. Slope value gives delta j/delta sigma estimates of the anomalous source. The intercept furnishes information on anomaly interference. Cluster analysis consists of the classification of subsets of data into groups of similarity based on correlation of selected characteristics of the anomalies. Model studies are used to illustrate implementation and interpretation procedures of these methods, particularly internal correspondence. Analysis of the results of applying these methods to data from the midcontinent and a transcontinental profile shows they can be useful in identifying crustal provinces, providing information on horizontal and vertical variations of physical properties over province size zones, validating long wavelength anomalies, and isolating geomagnetic field removal problems.
Author

N77-27650# California Univ., Livermore. Lawrence Livermore Lab.
ESTIMATES OF THE EPICENTRAL GROUND MOTION IN THE CENTRAL AND EASTERN UNITED STATES
Don L. Bernreuter Jun. 1976 9 p refs Presented at 6th World Earthquake Conf., New Delhi, 10-4 Jan. 1977
(Contract W-7405-eng-48)
(UCRL-78369; Conf-770103-5) Avail: NTIS HC A02/MF A01

Seismic ground motion from earthquakes in the central U.S. recorded at regional distances is used as a basis to make estimates of the strong ground motion that could be expected from future earthquakes in the central U.S. The method used to back extrapolate the data into the near field is shown to be valid by use of data from earthquakes and underground nuclear explosions. The results of this study show that the estimated peak accelera-

tions in the epicentral region are similar to that observed elsewhere throughout the world. The differences between these results and the lower values predicted by Nuttli are also discussed. ERA

N77-27651# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY AND TECHNOLOGY REVIEW
R. W. Selden Nov. 1976 17 p refs
(Contract W-7405-eng-48)
(UCRL-52000-76-11) Avail: NTIS HC A02/MF A01

The resolution of serious discrepancy between lunar magnetic field data and melting studies of lunar basalts is discussed. Estimates of the subsurface temperature, based on lunar electrical conductivity measurements and laboratory experiments, were hundreds of degrees below those given by models using known melting points of various minerals. A basic flaw in previous measurements was uncovered. New measurements under more realistic conditions brought the electrical conductivity temperature estimates into agreement with temperatures derived from melting experiments. A satellite ozone analysis center is also described. It is expected to produce daily high resolution global maps of ozone concentration. Correlated with ground observations, these maps should make it possible to establish the average ozone level, to check the effects of solar flares, volcanic eruptions, and atmospheric nuclear tests on that level, to detect long term trends in ozone concentration, and eventually to predict the effects of various forms of atmospheric pollution. Finally, a computer pattern recognition system for analyzing crime is discussed. D.M.L

N77-27652# California Univ., Livermore. Lawrence Livermore Lab.
THEORETICAL MODEL OF GLOBAL TROPOSPHERIC OH DISTRIBUTIONS
J. S. Chang and D. J. Wuebbles 12 Oct. 1976 12 p refs Presented at Symp. on the Non-urban Tropospheric Composition, Hollywood, Fla., 9-12 Nov. 1976
(Contract W-7405-eng-48)
(UCRL-78392; Conf-761118-1) Avail: NTIS HC A02/MF A01

It is easy to estimate that the HO/sub x/species (OH, HO2 and H2O2) have very short lifetimes in the troposphere. It is possible to derive a good estimate of the two dimensional (latitudinal and vertical) global distribution of tropospheric OH through quasi-equilibrium analysis. Diurnal OH concentrations for various latitudes and seasons were derived from measurements of temperature, water vapor, methane, carbon monoxide and ozone. These OH concentrations were then used to determine the tropospheric chemical lifetime for a number of halocarbons based on chemical degradation by OH radical reactions. These chemical lifetimes are important in determining possible alternates for currently used fluorocarbons. ERA

N77-27653# Massachusetts Inst. of Tech., Cambridge.
SOURCE, SCATTERING AND ATTENUATION EFFECTS ON HIGH FREQUENCY SEISMIC WAVES Ph.D. Thesis
B. A. Chouet Sep. 1976 190 p refs
(Contract EY-76-S-02-2534)
(TID-27311) Avail: NTIS HC A09/MF A01

High frequency coda waves from small local earthquakes are interpreted as backscattering waves from numerous heterogeneities distributed uniformly in the earth's crust. Two extreme models of the wave medium that account for the observations on the coda are proposed. The sensitivity of the high frequency coda waves to changes in the medium structure is demonstrated in the data collected at Stone Canyon, California. The temporal change in behavior of the 24 Hz coda observed in this region is interpreted as being related mainly to an increase of the intrinsic Q in the shallow crust. ERA

N77-27654# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
ECHOSONDE DETECTION OF THE ABRUPT TRANSITION FROM A LAMINAR TO A TURBULENT PLANETARY BOUNDARY LAYER
J. F. Schubert 1976 18 p refs Presented at Acoust. Soc. Am. Meeting, San Diego, Calif., 16-19 Nov. 1976
(Contract E(07-2)-1)
(DP-MS-76-56; Conf-761138-1) Avail: NTIS HC A02/MF A01

From a continuous collection of this data, an acoustic climatology of the general area can be constructed. Routine data were collected over the Savannah River Plant site during certain periods at nights after a frontal passage and while the general area was under the influence of high atmospheric pressure. These data showed an abrupt transition from a laminar layered structure to a well-mixed atmospheric boundary layer. ERA

N77-27655# Logicon, Inc., Bedford, Mass.
ANALYSIS AND PROGRAMMING FOR RESEARCH IN PHYSICS OF THE UPPER ATMOSPHERE Final Report, 1 Sep. 1974 - 31 Aug. 1976
James N. Bass, Krishin N. Bhavnani, Ben-Zion J. Guz, Robert R. Hayes, and Paul N. Houle Hanscom AFB, Mass. AFGL 30 Sep. 1976 213 p refs
(Contract F19628-75-C-0039)
(AD-A034066; AFGL-TR-76-0231) Avail: NTIS HC A10/MF A01 CSCL 04/1

This report describes significant analyses and computer programming problems performed in support of Air Force Geophysics Laboratory scientists. Mathematical and logical procedures are discussed, and samples of results are presented. Astronomical ephemeris programs include solar-lunar and stellar viewing information, and special plots. GRA

N77-27656# Aeronutronic Ford Corp., Billings, Mont. Engineering Services Div.
MONTANA LARGE APERTURE SEISMIC ARRAY Semiannual Technical Report, 1 Jan. - 30 Sep. 1976
Robert E. Matkins 29 Oct. 1976 67 p refs
(Contract F08606-76-C-0005)
(AD-A033728; TR-2126-76-85) Avail: NTIS HC A04/MF A01 CSCL 17/10

The continued operation, maintenance, and array improvement activities at the Montana LASA are described. Array operations including the preparation of daily teleseismic event reports are detailed. Results of the seismic event processing effort are reported. Seismograph system performance measurements are presented. Program maintenance for the PDP-7 computer system is indicated. GRA

N77-27657# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
EARTHQUAKE DATA FILE SUMMARY
Herbert Meyers and Carl A. VonHake May 1976 59 p refs
(PB-265445/7; NOAA-77030214) Avail: NTIS HC A04/MF A01 CSCL 08K

The Earthquake Data File is a magnetic tape file of earthquake origin times, locations, magnitudes, and related information on effects that have been compiled from many sources. It is a useful tool for providing searches of the seismicity of selected regions, for preparing lists of earthquakes of given characteristics (large magnitude, intensity, tsunami, etc.) for plotting maps, and for making statistical studies. GRA

N77-27658# National Oceanic and Atmospheric Administration, Seattle, Wash. Pacific Marine Environmental Lab.
A GENERAL MODEL OF THE OCEAN MIXED LAYER USING A TWO-COMPONENT TURBULENT KINETIC ENERGY BUDGET WITH MEAN TURBULENT FIELD CLOSURE Ph.D. Thesis - Washington Univ., Seattle
Roland W. Garwood, Jr. Sep. 1976 95 p refs
(PB-265434/1; NOAA-TR-ERL-384; NOAA-TR-ERL-384-PMEL-27; NOAA-77021615) Avail: NTIS HC A05/MF A01 CSCL 08C

A non-stationary, one-dimensional bulk model of a mixed layer bounded by a free surface above and a stable nonturbulent region below is derived. The vertical and horizontal components of turbulent kinetic energy are determined implicitly, along with layer depth, mean momentum, and mean buoyancy. Both layer growth by entrainment and layer retreat in the event of a collapse of the vertical motions due to buoyant damping and dissipation are predicted. Specific features of the turbulent energy budget include mean turbulent field modeling of the dissipation term, the energy redistribution terms, and the term for the convergence

of buoyancy flux at the stable interface (making possible entrainment). GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N77-27659 Oklahoma Univ., Norman.
THE USE OF FILTERED SURFACE DATA TO REVEAL SUBSYNOPTIC SCALE DYNAMICS Ph.D. Thesis
Charles Arthur Doswell, III 1976 140 p
Avail: Univ. Microfilms Order No. 77-1819

A band-pass filtering technique, based on an exponential weight function interpolation method, is presented. The technique filters both spatially and temporally and the center of the band can be positioned in the spectral domain to suit the needs of the user. Test data to which the filter is applied are conventional surface meteorological observations for three severe thunderstorm days in Oklahoma. By combining results of the filtering with available numerical studies a scale analysis for subsynoptic systems is developed. Surface subsynoptic systems are shown to be well correlated with severe weather events. Three fundamental findings about these systems are developed. Dissert. Abstr.

N77-27660 California Univ., Berkeley.
THERMODYNAMIC EFFECTS OF CLOUDS IN THE TRADEWIND PLANETARY BOUNDARY LAYER Ph.D. Thesis
Steven Kristian Esbensen 1976 128 p
Avail: Univ. Microfilms Order No. 77-1626

A model of deep cumulus clouds and a model of shallow cumulus clouds are combined with large-scale heat and moisture budgets to diagnose the thermodynamic effects of clouds in the tradewind planetary boundary layer. It is proposed that a distinction between deep and shallow clouds be made on the basis of whether the clouds can or cannot generate net kinetic energy through buoyancy forces. Dissert. Abstr.

N77-27661*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EARTH RADIATION BUDGET SATELLITE SYSTEM STUDIES
Charles V. Woerner and John E. Cooper May 1977 63 p refs
(NASA-TM-X-72776) Avail: NTIS HC A04/MF A01 CSCL 04B

The scientific objectives and the associated mission analysis, instrument definition, and data analysis methods are discussed. Author

N77-27662# Atmospheric Science Associates, Bedford, Mass.
ADDITIONAL STUDIES OF THE EFFECTS OF AIRPLANE FLOWFIELDS ON HYDROMETEOR CONCENTRATION MEASUREMENTS Final Report, 7 Jan. - 13 Aug. 1976
Hillyer G. Norment Hanscom AFB, Mass. AFGL 13 Aug. 1976 66 p refs
(Contract F19628-76-C-0142)
(AD-A032311; AFGL-TR-76-0187) Avail: NTIS HC A04/MF A01 CSCL 04/2

Hydrometeor concentrations seen by fuselage-mounted particle sampling instruments are distorted owing to flow around the airplane. A general, three-dimensional method is used to compute concentration distortion and sampling efficiency. Evidence to support the use of steady-state drag coefficients for accelerative particle motion is discussed. Assessments of sampling adequacies of several instruments mounted on a Learjet 36 airplane are reported. This includes a total water content indicator mounted inside the nose of the Learjet, assessment of which requires calculation of air and particle flow into the instrument orifice - a new application of the method. Finally a preliminary, generalized method is developed for estimation of safe sampling distances for fuselage-mounted instruments and results are compared with those of case studies. Author (GRA)

N77-27663# Woods Hole Oceanographic Institution, Mass.
NOTES ON THE 1976 SUMMER STUDY PROGRAM IN GEOPHYSICAL FLUID DYNAMICS AT THE WOODS HOLE OCEANOGRAPHIC INSTITUTION
1976 226 p refs
(Contract N00014-74-C-0262; Grant NSF ATM-73-06506)
(PB-256181/8; WHOI-Ref-76-81) Avail: NTIS HC A11/MF A01 CSCL 04B

A partial listing of topics includes: problems of climate modeling; paleoclimatic data; modeling ice caps; the earth's radiation balance; water mass analysis and the deep ocean circulation; upwelling near an ice edge; Martian climatology; dynamics of Jupiter's atmosphere; world ocean circulation; the bottom boundary layer of the deep ocean and the dynamics of sheared thermoclines. GRA

N77-27664# Mission Research Corp., Santa Barbara, Calif.
A LOW ALTITUDE METEOROLOGICAL DATA BASE Technical Report, 13 Nov. 1975 - 12 Nov. 1976
S. L. Gutsche and K. S. Smith Aug. 1976 353 p refs
(Contract DNA001-76-C-0051)
(AD-A039063; MRC-N-255; DNA-4102T) Avail: NTIS HC A15/MF A01 CSCL 04/2

This document describes a meteorological data base of the Northern Hemisphere for atmospheric pressure levels up to 50 mb (about 20 km). The quantities provided are those which have proven to be useful in certain calculations of nuclear effects, such as modeling fireball rise and late time debris cloud movement. These quantities (provided at pressure levels of 850, 700, 500, 300, 200, 150, 100, and 50 mb) are: (1) mean easterly windspeed, (2) mean northerly windspeed, (3) vector standard deviation of windspeed, (4) temperature, (5) standard deviation of temperature, (6) dew point temperature, and (7) standard deviation of dew point temperature. The data is provided for all twelve months and seasons at five degree increments of latitude and longitude. How to access digital data appropriate for the four seasons and each month individually which is contained on magnetic computer tapes available through MRC or the DNA nuclear effects library, DASIAC, is described. In Appendix A, printed output from the data base for the seven quantities and eight pressure levels mentioned above is presented for the four seasons (output for each month would require more volumes). GRA

N77-27665# Aeromet, Inc., Norman, Okla.
HAWADS EQUIPMENT DESCRIPTION AND OPERATIONAL MANUAL Final Report, 22 Sep. 1975 - 31 Dec. 1976
D. Ray Booker and Joe Windes Hanscom AFB, Mass. AFGL 12 Jan. 1977 128 p ref
(Contract F19628-76-C-0103)
(AD-A038469; Rept-770112; AFGL-TR-77-0066) Avail: NTIS HC A07/MF A01 CSCL 04/2

A High Altitude Weather Aircraft Data System (HAWADS) installed in a Learjet Model 36 aircraft is described. The aircraft was selected because of it's high altitude performance and long range. The instrument system includes flight conditions sensors and five optical particle spectrometer probes. Two are very high speed probes for making 2D images of clouds and precipitation particles. A computer is included for realtime computations of cloud water content and radar reflectivity. Principles of operation, detailed operational, calibration and maintenance procedures are described. Author (GRA)

N77-27666# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Labs.
FISCAL YEAR 1975 SUMMARY REPORT OF NOAA METEOROLOGY LABORATORY SUPPORT TO THE ENVIRONMENTAL PROTECTION AGENCY
Herbert J. Viebrock, ed. (Natl. Environ. Res. Center, Res. Triangle Park, N. C.) Jul. 1976 128 p refs
(PB-265380/6; NOAA-TM-ERL-ARL-62; NOAA-77020206)
Avail: NTIS HC A07/MF A01 CSCL 04A

The meteorological aspects of environmental impact statements, requests for variances, implementation plans, and grant and contract proposals are discussed along with the application of dispersion models, and the preparation of dispersion studies and evaluations. Research support in the areas of model development and application, climatic analysis, and atmospheric effects of pollutants is described. Dispersion models for inert

and reactive pollutants, regional and boundary layer meteorological models, and models of the pollutant removal processes are included. GRA

N77-27667# California State Dept. of Water Resources, Sacramento.
RAINFALL ANALYSIS FOR DRAINAGE DESIGN. VOLUME 1: SHORT-DURATION PRECIPITATION FREQUENCY DATA Final Report
J. D. Goodridge Oct. 1975 683 p refs Sponsored jointly by Federal Highway Admin. and Calif. State Dept. of Transportation 3 Vol.
(PB-265000/0; Bull-195-Vol-1; FHWA-CA-76-195-Vol-1) Avail: NTIS HC A99/MF A01; also available in set of 3 reports PC E15, PB-264999-SET CSCL 04B

The depth-duration-frequency of precipitation in California was analyzed. The annual series extreme values from about 30 rain gage networks in California are given. A statistical analysis of each record is available, giving 12 return periods ranging from 2 to 10,000 years and durations of 5 minutes to 60 days, including the annual total precipitation. Methods of interstation interpolation are also given. Precipitation, depth-duration-frequency data, and analyses from 600 recording rain gages with durations ranging from 5 minutes to 24 hours are reported. The data contained are intended for use in runoff computation using procedures such as the rational method or the unit hydrograph method. GRA

N77-27668# California State Dept. of Water Resources, Sacramento.
RAINFALL ANALYSIS FOR DRAINAGE DESIGN. VOLUME 2: LONG-DURATION PRECIPITATION FREQUENCY DATA Final Report
J. D. Goodridge Oct. 1976 396 p refs Sponsored jointly by Federal Highway Admin. and Calif. State Dept. of Transportation 3 Vol.
(PB-265001/8; Bull-195-Vol-2; FHWA-CA-76-195-Vol-2) Avail: NTIS HC A17/MF A01; also available in set of 3 reports PC E15, PB-264999-SET CSCL 04B

Depth-duration-frequency analysis of precipitation with durations of one day to 60 days from 900 nonrecording rain gages are reported. The data contained are intended for use in runoff computation using procedures such as the rational method or the unit hydrograph method. For vol.1, see N77-27667. GRA

N77-27669# California State Dept. of Water Resources, Sacramento.
RAINFALL ANALYSIS FOR DRAINAGE DESIGN. VOLUME 3: INTENSITY-DURATION-FREQUENCY CURVES Final Report
J. D. Goodridge Oct. 1976 313 p refs Sponsored jointly by Federal Highway Admin. and Calif. State Dept. of Transportation 3 Vol.
(PB-265002/6; Bull-195-Vol-3; FHWA-CA-76-195-Vol-3) Avail: NTIS HC A14/MF A01; also available in set of 3 reports PC E15, PB-264999-SET CSCL 04B

Precipitation intensity-duration-frequency curves from 500 recording rain gages, based on maximum annual rainfall depths for 5 to 180 minutes are presented. For vol. 1, see N77-27667. GRA

N77-27670# Hydroscience Associates, Inc., Westwood, N. J.
SYNOPTIC RAINFALL DATA ANALYSIS PROGRAM (SYNOP) Final Report
Jul. 1976 115 p
(Contract EPA-68-03-2428)
(PB-264563/8; EPA-600/9-76-014b; EPA/DF-77/002a) Avail: NTIS HC A06/MF A01 CSCL 13B

Statistical analysis of variables of interest (volume, duration, intensity, and time between storms) are given to determine seasonal trends which are of importance in accessing impact and selecting control alternatives for storm related loads. GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N77-27671 State Univ. of New York, Albany.
PETROLOGY OF THE OCEANOGRAPHER FRACTURE ZONE (35 DEG N, 35 DEG W) Ph.D. Thesis
Tsugio Shibata 1976 136 p
Avail: Univ. Microfilms Order No 77-3472

During a geological and geophysical survey by the Oceanographer Fracture Zone, seventeen dredge hauls containing a variety of rocks were obtained. Petrographic study shows that these rock samples can be classified into six main rock types: fresh basalt, weathered basalt, metabasalt, gabbro, metagabbro, and serpentinite. Major element analyses of tholeiitic basalts from two adjacent dredge hauls show that these tholeiitic basalts are closely related chemically and that they apparently represent points on a continuous liquid line of descent. Metamorphic rocks from the Oceanographer Fracture Zone range in metamorphic grade from zeolite to greenschist facies. Metabasalts are massive and show no evidence of deformation; metagabbros are to some degree deformed. Petrographic study of these metagabbros indicates that plagioclase grains are commonly strained, bent, and ruptured, whereas pyroxene and hornblende grains are replaced by a metamorphic mineral assemblage made up mainly of actinolite and chlorite. Dissert. Abstr.

N77-27672 Old Dominion Univ., Norfolk, Va.
NUMERICAL SIMULATION OF THERMOHALINE CONVECTION IN THE MIXED LAYER OF THE OCEAN Ph.D. Thesis
Victor Eli Delnore 1976 175 p
Avail: Univ. Microfilms Order No. 77-2303

The intradiurnal heating and cooling cycle of the mixed layer of a tropical ocean was investigated using a pseudo-two-dimensional numerical model. Particular emphasis was given to two-component diffusion resulting from dynamic instabilities in the water column. The conservation equations for salt and heat included the effects of solar heating, horizontal advection, and turbulent fluxes at the sea surface, while wind mixing entered through the use of depth-dependent eddy diffusion coefficients resulting from a wave-orbital shear model. All inputs were treated as functions of time of day, or calculated via the bulk aerodynamic method. Temperature profiles generated using the model were compared to profiles observed in the ocean. Good agreement, was found especially in predicting the shape of the heat wave at 1 m vertical resolution during the daily cycle. Dissert. Abstr.

N77-27673*# Scientific Translation Service, Santa Barbara, Calif.
SEA FOAM, PHYSICOCHEMICAL PROPERTIES, RADIATING AND REFLECTING CHARACTERISTICS
V. Yu. Rayzer, Ye. A. Sharkov, and V. S. Etkin Washington NASA Jun. 1977 44 p refs Transl. into ENGLISH of "Morskaya Pena, Fiziko Khimicheskiye Svoystva, Izluchitelnyye i Otrazhatelnyye Kharakteristiki", Pr-306 Inst. of Space Res., Acad. of Sci. USSR, Moscow, 1976 p 1-59
(Contract NASw-2791)
(NASA-TT-F-17541; Pr-306) Avail: NTIS HC A03/MF A01 CSCL 08J

Dielectric models of foam structures are examined which are used for interpreting microwave data. Author

N77-27674# Naval Intelligence Support Center, Washington, D. C. Translation Div.
CONCERNING THE EFFECT OF SEA CURRENTS ON FREE INTERNAL GRAVITATIONAL WAVES
V. G. Savchenko and V. R. Fuks 1 Feb. 1977 10 p refs Transl. into ENGLISH from Tr. Arkt. Antarkt. Nauch.-Issled. Inst. (USSR), v. 301 1972 p 114-123
(AD-A036889; NISC-Trans-3899) Avail: NTIS HC A02/MF A01 CSCL 08/3

Free internal gravitational waves arise as a reaction of a stably stratified heterogeneous liquid to an energetic external action. They carry energy from the region of an initial disturbance to the ambient space, tending to return the liquid to the initial state of equilibrium. In the majority of theoretical studies of

free internal gravitational waves in the ocean, the basic assumption is that they are small harmonic oscillations of an ideal incompressible liquid about a certain state of equilibrium. The state of rest is usually taken as this state of equilibrium. In this case, the system of fluid mechanics equations describing the unperturbed state of equilibrium is reduced to a single equation of statics. Such a choice of the principal state is equivalent to neglecting the convection terms in linearized equations for perturbations, in comparison with local changes. V. Krauss notes that this operation is inadmissible in the study of tidal internal waves. A similar situation arises in the study of other types of internal gravitational waves, whose phase velocities are comparable to the velocities of sea currents existing in the initial state of equilibrium. Since the spectrum of phase velocities of internal gravitational waves in the ocean is fairly wide, and a certain average transport of waters is the rule rather than the exception for all regions of the World Ocean, it appears that sea currents (the main flow) must be considered in order to explain many aspects of the dynamics of internal gravitational waves. GRA

N77-27675# Chicago Univ., Ill. Fluid Dynamics and Sediment Transport Lab.
A SELF-CONTAINED FACILITY FOR ANALYZING NEAR BOTTOM FLOW AND ASSOCIATED SEDIMENT TRANSPORT
B. Lesht, R. V. White, and R. L. Miller Oct. 1976 44 p refs Sponsored by NOAA
(PB-265277/4; NOAA-77030803; NOAA-TM-ERL-MESA-9) Avail: NTIS HC A03/MF A01 CSCL 08J

The field system was designed to monitor several aspects of the near bottom environment. The system can measure and record horizontal velocities at several levels within one meter of the ocean floor. Simultaneous measurements of wave pressure, mean current direction and turbidity can also be recorded. The recorded information is stored in digital format facilitating later analysis. The system is relatively inexpensive, flexible, and can be easily transported by small truck to the field location. Several experiments have been conducted with success in the New York Bight. GRA

N77-27676# National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.
SELF-CONTAINED DIGITAL TIDE MEASUREMENT SYSTEM
Benjamin Culverhouse Jan. 1977 50 p refs
(PB-265269/1; NOAA-TM-ERL-AOML-24; NOAA-77030309) Avail: NTIS HC A03/MF A01 CSCL 08C

A digital recording, self-contained tide measurement system for Continental Shelf oceanography is described. Design parameters, construction techniques, sensor calibrations, and system tests are discussed. Pressure and temperature are measured through the use of a high precision quartz crystal and a precision epoxy-coated thermistor. Data are recorded on digital cassettes with a capacity of 11 million bits. GRA

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N77-27677* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AUTOMATED SINGLE-SLIDE STAINING DEVICE Patent
Judd R. Wilkins and Stacey M. Mills, inventors (to NASA) Issued 14 Jun. 1977 10 p Filed 29 Oct. 1975 Supersedes N76-13725 (14 - 04, p 0487)
(NASA-Case-LAR-11649-1; US-Patent-4,029,470; US-Patent-Appl-SN-626942; US-Patent-Class-8-94.11; US-Patent-Class-8-3; US-Patent-Class-23-253A; US-Patent-Class-23-259; US-Patent-Class-23-292; US-Patent-Class-118-6; US-Patent-Class-118-7; US-Patent-Class-118-9; US-Patent-Class-118-313; US-Patent-Class-424-3; US-Patent-Class-427-4) Avail: US Patent Office CSCL 06M

A simple apparatus and method is disclosed for making individual single Gram stains on bacteria inoculated slides to assist in classifying bacteria in the laboratory as Gram-positive or Gram-negative. The apparatus involves positioning a single inoculated slide in a stationary position and thereafter automatically and sequentially flooding the slide with increments of a primary stain, a mordant, a decolorizer, a counterstain and a wash solution in a sequential manner without the individual lab technician touching the slide and with minimum danger of contamination thereof from other slides. NASA

N77-27678 Pittsburgh Univ., Pa.
THE ISOLATION AND PURIFICATION OF PROTEIN FRACTIONS INVOLVED IN E. COLI DNA REPLICATION Ph.D. Thesis
Katryna Bogovich 1976 178 p
Avail: Univ. Microfilms Order No. 77-2990

A method has been developed for the isolation and purification of protein fractions which appear to be involved in the semiconservative replication of the bacterial nucleoid. The procedure for isolating and purifying the enzymatic fractions consists of separating the 0-50 percent ammonium sulfate out of a high speed cell lysate supernatant into three fractions via a DEAE - cellulose column. The resultant fractions, the 50 mM NaCl breakthrough; the 50-200 mM NaCl fraction; and the 200-600 mM NaCl fraction, were further purified either via gel filtration followed by DEAE - cellulose chromatography or by phosphocellulose chromatography followed by DEAE - cellulose chromatography. The enzymatic fractions were purified on the basis of their ability to stimulate the ATP-dependent DNA synthetic ability of either a single stranded DNA specific protein fraction or a double stranded DNA specific protein fraction. Dissert. Abstr.

N77-27679 North Carolina State Univ., Raleigh.
RESPONSE OF GUINEA PIG EARS TO PURE TONES, SPEECH, AND OTHER COMPLEX WAVEFORMS IMPARTED ACOUSTICALLY AND BY OSSICULAR CHAIN COUPLED PIEZOELECTRIC TYPE TRANSDUCERS Ph.D. Thesis
Reginald Owen Cook 1976 352 p
Avail: Univ. Microfilms Order No. 77-2738

The feasibility study of imparting speech, complex waveforms, and pure tones onto the ossicular chain of guinea pigs by direct coupling with piezoelectric transducers was carried out. Comparisons were made of the response of the middle and inner ear (cochlea) to identical source waveforms presented in the normal acoustic manner and presented via direct coupled piezoelectric type devices. The data obtained offer compelling evidence for the essential equivalency of direct coupled and acoustically generated means of imparting signals onto the auditory system and of the feasibility of the technique in producing response free from unwanted shock, distortion, or other fidelity degrading side effects. Dissert. Abstr.

N77-27680*# Michigan Univ., Ann Arbor. Kresge Hearing Research Inst.
DEVELOPMENT OF METHODOLOGIES FOR VESTIBULAR EXPERIMENTATION WITH MAN AND ANIMALS Final Report
D. J. Anderson 25 Apr. 1977 38 p refs
(NASA-CR-151444) Avail: NTIS HC A03/MF A01 CSCL 06D

Calculations on the possibilities for an animal centrifuse which will be useful in the study of the otolith organs in space research are presented with discussion on the design of such a centrifuse. Author

N77-27681*# Dartmouth Coll., Hanover, N.H. Dept. of Physiology.
THE THYROID AND ENVIRONMENTAL STRESS IN MAMMALS Final Report, 1 Jan. 1975 - 31 Dec. 1976
Valerie Anne Galton 10 Jun. 1977 39 p refs
(Contract NAS9-14439)
(NASA-CR-151462) Avail: NTIS HC A03/MF A01 CSCL 06C

The effects of hyperoxia at ambient pressure on thyroid function and thyroid hormone metabolism have been assessed. Thyroidal activity was depressed in mice and rats by exposure to hyperoxia, due at least in part to a decrease in the rate of secretion of pituitary thyrotropin. The effects of hyperoxia on the peripheral deiodination of thyroxine were dependent on the

concentration of oxygen employed and/or the duration of exposure. When significant changes were observed a reduction in the rate of deiodination and in the deiodinative clearance of T sub 4 occurred. Hyperoxia also resulted in a marked fall in circulating T sub 4 concentration and a decrease in T sub 4-binding activity in serum. Many of these effects of hyperoxia were prevented by the concomitant administration of large amounts of Vitamin E. These decreases in thyroid function and T sub 4 metabolism were associated with a decrease in the rate of whole body oxygen consumption. It was concluded that the deleterious effects of oxygen in the rat were not due to an oxygen induced hyperthyroid state in the peripheral tissues. Thyroxine was shown to be essential for survival during acute cold stress. Author

N77-27682*# Hardin-Simmons Univ., Abilene, Tex. Science Research Center.
RESPONSE OF SELECTED MICROORGANISMS TO EXPERIMENTAL PLANETARY ENVIRONMENTS Semiannual Progress Report, 1 Jul. 1976 - 30 Jun. 1977
Terry L. Foster and Luther Winans, Jr. Jun. 1977 38 p
(Grant NGR-44-095-001)
(NASA-CR-153912; PR-9) Avail: NTIS HC A03/MF A01 CSCL 06C

Results of studies in anaerobic phosphorus metabolism are presented. Specific topics discussed include: (1) anaerobic utilization of PH3; (2) reduction of phosphate or phosphite; (3) isolation of organisms which utilize phosphite or phosphate anaerobically as a final hydrogen acceptor; and (4) the toxicity of PH3 to the organisms. Techniques of anaerobic microbiology associated with space hardware were also studied. These include: (1) the Brewer anaerobe jar/GasPak system; (2) a new procedure to grow aerobes and anaerobes simultaneously; (3) a culture medium to differentiate oblagate from facultative anaerobes; and (4) a procedure to quantitate O2 sensitivity of anaerobes. J.M.S.

N77-27683# Nebraska Univ., Lincoln. Dept. of Food Science and Technology.
PREPARATION AND EVALUATION OF IMMOBILIZED SINGLE AND MULTIPLE ENZYME SYSTEMS Ph.D. Thesis
Arun Kilara Oct. 1976 155 p refs
(Contract DI-14-34-0001-6028)
(PB-264898/8; W77-05724; OWRT-A-040-NEB(1)) Avail: NTIS HC A08/MF A01 CSCL 06A

The effects of immobilization on the pH and temperature of assay and kinetic parameters such as apparent Michaelis constant and apparent maximal velocity for each enzyme were investigated. It was felt the immobilized multiple enzyme system could be successfully used for the hydrolysis of lactose, proteins and lipids in cheese whey. GRA

N77-27684# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: BIOMEDICAL SCIENCES, NO. 4
11 Jul. 1977 57 p refs Transl. into ENGLISH from Russian journals
(JPRS-69399) Avail: NTIS HC A04/MF A01

Information on aerospace medicine, agrotechnology, bionics and bioacoustics, biochemistry, biophysics, environmental and ecological problems, food technology, microbiology, epidemiology and immunology, marine biology, military medicine, physiology, public health, toxicology, radiobiology, veterinary medicine, behavioral science, human engineering, psychology, psychiatry and related fields, and scientists, and scientific organizations in biomedical fields is presented. Author

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N77-27685 Purdue Univ., Lafayette, Ind.
POTASSIUM PERMEABILITY IN THE TRANSVERSE TUBULE SYSTEM AND LATENCY RELAXATION: A STUDY OF EXCITATION-CONTRACTION COUPLING Ph.D. Thesis
Glenn Edward Kirsch 1976 157 p
Avail: Univ. Microfilms Order No. 77-1735

In skeletal muscle, many of the processes linking excitation of the surface membrane with contraction of the myofilaments take place within two intracellular membrane systems: the transverse tubule system (TTS) and the sarcoplasmic reticulum (SR). The origin of the late afterpotential (LAP) was studied because it is believed to be caused by potassium accumulation following the activation of delayed rectification in the TTS. Latency relaxation (LR) was studied because of its postulated relationship to calcium release from the SR. Results support the potassium accumulation hypothesis and the idea that delayed rectification occurs in the TTS. A calculation of the amount of potassium released by a single spike in the TTS showed that the distribution of delayed rectifier channels is less dense in the TTS than on the surface. Dissert. Abstr.

N77-27686 Texas A&M Univ., College Station.
THE EFFECTS OF INCREASED OXYGEN CONCENTRATIONS AND ACCELERATION FORCES ON THE MECHANICAL PROPERTIES OF THE LUNGS Ph.D. Thesis
Larry Todd Bush 1976 140 p
Avail: Univ. Microfilms Order No. 77-2601

The effects of breathing increased concentrations of oxygen (FIO2's of 0.6 to 1.0) on the pulmonary compliance and pulmonary resistance were examined in normal, seated males. Exposures were for one hour, and volume histories of the lungs were established at 10 minute intervals. There were no significant changes in any of the parameters examined. In addition, the effects of breathing increased oxygen concentrations and exposure to increased acceleration forces on pulmonary compliance and resistance were examined in normal, seated males. Pulmonary compliance decreased significantly in subjects breathing the increased FIO2's after exposure to acceleration forces when compared to room air controls. The decrease in compliance appeared to be a function of the FIO2, with those subjects breathing the greater FIO2 showing a greater decrease in compliance than those subjects breathing the lesser FIO2. There was no significant difference in the degree of compliance decrease between the two acceleration levels for a particular FIO2. Dissert. Abstr.

N77-27687 Ohio State Univ., Columbus.
INTERACTION BETWEEN THE HEART AND THE VASCULAR SYSTEM: A CIRCUIT APPROACH Ph.D. Thesis
Jean-Pierre Dujardin 1976 169 p
Avail: Univ. Microfilms Order No. 77-2391

The interaction between the heart and the vascular system is studied by using circuit theory. It was shown that the left ventricle can be represented as an ideal flow source in parallel with a source resistor. It was also shown that the arterial system can be described by the total arterial compliance, the characteristic impedance of the proximal aorta and the relationship of the total peripheral run-off versus the mean arterial pressure. All these parameters, characterizing the left ventricle and the arterial system were measured in vivo in closed chest dogs. A mathematical method was introduced to calculate the steady state values for arterial pressure, systolic outflow of the left ventricle and arterial steady power. Dissert. Abstr.

N77-27688 Kent State Univ., Ohio.
CIRCADIAN VARIATIONS IN RESPONSES OF TRAINED AND UNTRAINED MEN TO SUBMAXIMAL EXERCISE Ph.D. Thesis
Paul Michael Couzelis 1976 226 p
Avail: Univ. Microfilms Order No. 77-3821

Twenty-four hour variations of the cardiorespiratory system are examined to determine whether physiologically meaningful circadian rhythms could be detected in groups of men during exercise. In addition, the possible effect of physical training at the same time each day, as an environmental synchronizer of circadian rhythms, was determined. A number of cardiorespiratory parameters were observed during 11 minute bouts of submaximal bicycle ergometer exercise performed every 3 hours for 24 hours. It was concluded that group synchronized circadian rhythms during exercise can be found in systolic blood pressure, diastolic blood

pressure, pulse pressure, tidal volume, blood lactate, and serum potassium. Dissert. Abstr.

N77-27689 Indiana Univ., Bloomington.
PACE AND GRADE RELATED TO THE OXYGEN AND ENERGY REQUIREMENTS, AND THE MECHANICS OF TREADMILL RUNNING Ph.D. Thesis
Phillip Likins Henson 1976 139 p
Avail: Univ. Microfilms Order No. 77-1986

The relationships among variations in running speed and grade, and their effects upon various physiological variables in running at a steady state, are investigated. Also determined were changes in various biomechanical variables which occurred along with changes in speed and grade. Some of the conclusions drawn from the investigation were: energy is conserved by running downhill. However, the savings are less than the additional amount required to run the same incline at the same speed; and uphill running is accompanied by a slight forward body lean toward the incline. Dissert. Abstr.

N77-27690 Colorado Univ., Boulder.
DYNAMIC ANALYSIS OF THE THORACIC STRUCTURE SUBJECTED TO IMPACT LOADINGS Ph.D. Thesis
Swaminathan Halasya Sundaram 1976 260 p
Avail: Univ. Microfilms Order No. 77-3241

Passenger protection and injury diagnoses in frontal automobile impacts were studied. A detailed dynamic model of the occupant before and after impact was developed. The occupant's pre-impact motion was analyzed using a three mass (representing the legs, torso, and head), three degree of freedom rigid body model. The three simultaneous nonlinear differential equations of motion of the system were solved numerically by a linear acceleration, time step integration algorithm. A parametric study of the collision variables was performed in which the vehicle velocity, pulse characteristics, seat friction, initial body position, and seat belt stiffness were varied discretely. The motion of the body from the instant of collision with the steering column until the completion of one cycle of compression and decompression was analyzed by treating the thorax as a deformable system of finite elements. Before a proper dynamic analysis was undertaken, static analyses were performed. Dissert. Abstr.

N77-27691 North Carolina Univ., Chapel Hill.
PULSATILE PRESSURE-FLOW DYNAMICS IN RESTING SKELETAL MUSCLE Ph.D. Thesis
Richard Ward Scearce, Jr. 1976 147 p
Avail: Univ. Microfilms Order No. 77-2092

The effects of pulse pressure amplitude and mean perfusion pressure on blood flow through an isolated denervated gracilis muscle of a dog were studied. A pressure regulated pumping system produced the pulsatile perfusion pressure which was composed of a sinusoidal pulse pressure and a mean pressure. Pulse pressure amplitudes of 20, 40, 60, 80, and 100 mm Hg were used in various combinations with pulse pressure frequencies of 0.1, 0.3, 0.5, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, and 7.0 Hz., and mean perfusion pressures of 50, 75, 100, 125, and 150 mm Hg. There were two experimental procedures: mean pressure was held constant while pulse amplitude and frequency were varied, and pulse amplitude and frequency were held constant while mean pressure was varied. Pulsatile pressure and flow data were recorded on magnetic tape and analyzed on a digital computer. Dissert Abstr.

N77-27692*# Harding Coll., Searcy, Ark.
STUDY OF OPTIMAL TRAINING PROTOCOLS AND DEVICES FOR DEVELOPING AND MAINTAINING PHYSICAL FITNESS IN FEMALES PRIOR TO AND DURING SPACE FLIGHT Progress Report, 1 Sep. 1976 - 28 Feb. 1977
Harry D. Olree, Bob Corbin, and Carroll Smith 28 Feb. 1977 21 p refs
(Contract NAS9-14921)
(NASA-CR-151246) Avail: NTIS HC A02/MF A01 CSCL 06P

Pedalling a bicycle at least ten minutes a day at 85% of maximum pulse rate, three days a week for ten weeks will produce moderate increases in overall strength and physical work capacity in college-age females. The longer the training session, up to thirty minutes per session, the greater are the increases in physical work capacity that result when college-age females are trained three days a week for ten weeks at 85% of their maximum heart rate. Author

N77-27693*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
SYSTEM FOR AND METHOD OF FREEZING BIOLOGICAL TISSUE Patent Application
Thomas E. Williams and Thomas A. Cygnarowicz, inventors (to NASA) Filed 14 Jun. 1977 18 p
(NASA-Case-GSC-12173-1; US-Patent-Appl-SN-806440) Avail: NTIS HC A02/MF A01 CSCL 06B

Blood cells, blood marrow, and other similar biological tissue is frozen while in a polyethylene bag placed in an abutting relationship against opposed walls of a pair of heaters. The bag and tissue are cooled with refrigerating gas at a time programmed rate at least equal to the maximum cooling rate needed at any time during the freezing process. The temperature of the bag, and hence of the tissue, is compared with a time programmed desired value for the tissue temperature to derive an error indication. The heater is activated in response to the error indication so that the temperature of the tissue follows the desired value for the time programmed tissue temperature. The tissue is heated to compensate for excessive cooling of the tissue as a result of the cooling by the refrigerating gas. In response to the error signal, the heater is deactivated while the latent heat of fusion is being removed from the tissue while the tissue is changing its phase from liquid to solid. NASA

N77-27694*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
LOCKING MECHANISM FOR ORTHOPEDIC BRACES Patent Application
Jireh I-Le Chao (Howard Univ.) and Charles H. Epps, Jr., inventors (to NASA) (Howard Univ.) Filed 20 May 1977 15 p Sponsored by NASA
(NASA-Case-GSC-12082-2; US-Patent-Appl-SN-798976) Avail: NTIS HC A02/MF A01 CSCL 06B

A locking mechanism for orthopedic braces is described which automatically prevents or permits the relative pivotable movement between a lower brace member and an upper brace member, the locking mechanism also including a secondary manually operable latching device. The upper and lower brace members are provided with drilled bores within which a slidable pin is disposed, and depending upon the inclination of the brace members with respect to a vertical plane, the slidable pin will be interposed between both brace members so as to prevent the relative pivotable movement therebetween, or alternatively, be disposed solely within the bore of the upper brace member so as to permit such relative pivotable movement therebetween. The secondary or auxiliary latching device includes a spring-biased, manually operable lever bar arrangement whereby the same is manually unlatched and automatically latched under the influence of the spring. NASA

N77-27695# Booz-Allen Applied Research, Inc., Bethesda, Md.
APPLICATION OF THE RESPONSE PROBABILITY DENSITY FUNCTION TECHNIQUE TO BIODYNAMIC MODELS Final Report
Robert L. Hershey and Thomas H. Higgins (FAA, Washington, D. C.) 1 Apr. 1977 25 p refs Sponsored by FAA
(AD-A040020; FAA-RD-77-52) Avail: NTIS HC A02/MF A01 CSCL 06/5

The response probability density function technique has applications to predicting probability of injury in a wide range of biodynamic situations. The method, which was developed in connection with sonic boom damage prediction, utilizes the probability density function of the excitation force and the probability density function of the sensitivity of the material being acted upon. The method is especially simple to use when both these probability density functions are lognormal. Studies show that the stresses from sonic booms, as well as the strengths of glass and mortars, are distributed lognormally. Some biodynamic processes also have lognormal distributions, and are therefore amenable to modeling by this technique. The application of the method to the analysis of the thoracic response to air blast and the prediction of skull fracture from head impact is discussed. Author

N77-27696# Civil Aeromedical Inst., Oklahoma City, Okla.
INTERMEDIATE VISUAL ACUITY OF PRESBYOPIC INDIVIDUALS WITH AND WITHOUT DISTANCE AND BIFOCAL LENS CORRECTIONS
Kenneth W. Welsh, Paul G. Rasmussen, and John A. Vaughan Mar. 1977 17 p refs
(AD-A038538/5; FAA-AM-77-7) Avail: NTIS HC A02/MF A01 CSCL 06/14

Visual acuity was determined at the intermediate range for older individuals with various combinations of ocular refractive error and accommodative power. Subjects read numerals ranging in size to measure visual acuity from 20/80 to 20/15 at 51, 76, and 102 cm with 50 fL luminance. Monocular visual acuity scores were determined both with the subject's optimum spectacle lens correction for distance vision and near vision and without lenses. For subjects with low accommodative power, neither the distance nor the near lens correction provides normal vision throughout the intermediate range. Individuals with myopia of less than 2.0 diopters (D) generally have better intermediate visual acuity without correction than with either a near or a distance correction. Younger subjects generally have better acuity under all conditions except subjects with uncorrected myopia exceeding 2.0 D. Author

N77-27697*# Joint Publications Research Service, Arlington, Va.
ROLE OF THE ADRENOCORTICAL REACTION TO PHYSICAL LOAD IN INCREASE IN THE WORKING CAPACITY OF THE BODY
A. A. Viru Washington NASA Jul. 1977 7 p refs Transl. into ENGLISH from Byull. Eksperim. Biol. i Med. (Moscow), no. 7, 1976 p 774-776
(NASA Order W-13183)
(NASA-TM-75026) Avail: NTIS HC A02/MF A01 CSCL 06P

The maximal duration of swimming by rats with a load of 3% of their body weight increased after 5 weeks of training. This time did not increase in animals receiving dexamethasone in the process of training. The blood corticosterone level of these rats with the maximal load increased less than that of animals trained without administration of dexamethasone. Author

N77-27698# Stanford Univ., Calif. Dept. of Statistics.
RELATING SPATIAL DISTRIBUTIONS OF POLLUTANTS TO HEALTH EFFECTS
T. W. Sager 15 Jul. 1976 24 p refs
(Contract EY-76-S-02-2874)
(COO-2874-1; TR-1) Avail: NTIS HC A02/MF A01

A new and potentially useful statistical tool for epidemiology is introduced, and some of its elementary properties are considered. The technique is a promising one for both data analytic and inferential problems. Starting with the collection of isopleths of a spatially distributed explanatory variable (air pollution), the method produces a relationship between the explanatory variable(s) and the response variable (population-adjusted health effects) by accumulating the response within successively wider isopleths. Among other appealing features, the method has some of the flavor of regression, reduces the relationship between three, three-dimensional distributions to a single easily interpreted two-dimensional graph, and effectively utilizes knowledge of the geographic location of data before discarding the location coordinates as nuisance parameters. ERA

N77-27699# Oak Ridge National Lab., Tenn.
TIMED: A COMPUTER PROGRAM FOR CALCULATING CUMULATED ACTIVITY OF A RADIONUCLIDE IN THE ORGANS OF THE HUMAN BODY AT A GIVEN TIME, t, AFTER DEPOSITION
S. B. Watson, W. S. Snyder, and M. R. Ford 1976 154 p refs
(Contract W-7405-eng-26)
(ORNL-CSD-TM-17) Avail: NTIS HC A08/MF A01

TIMED is a computer program designed to calculate cumulated radioactivity in the various source organs at various times after radionuclide deposition. TIMED embodies a system of differential equations which describes activity transfer in the lungs, gastrointestinal tract, and other organs of the body. This system accounts for delay of transfer of activity between compartments of the body and radioactive daughters. ERA

N77-27700# Argonne National Lab., Ill.
PULMONARY VENTILATION IMAGING AND FUNCTION STUDIES WITH KRYPTON-81m
E. Kaplan, L. W. Mayron, G. A. Gergans, A. M. Friedman, and J. E. Gindler 1976 14 p refs Presented at IAEA Symp. on Med. Radionuclide Imaging, Los Angeles, 25 Oct. 1976
(Contract W-31-109-eng-38)
(IAEA-SM-210/58; Conf-761060-9) Avail: NTIS HC A02/MF A01

Chronic obstructive lung disease is a significant entity throughout the world. To arrest asymptomatic disease, early diagnosis is required, implying an efficacious, reliable and available methodology, which has the potential for screening suspect populations. Krypton-81m is a 13-second radionuclide that emits a 190 keV gamma ray; it is produced from a rubidium-81- krypton-81m generator and delivery system. The generator effluent, in gaseous form, is continually inhaled by a subject while static equilibrium images and dynamic studies of ventilation are produced with a gamma scintillation camera system. The wash-in of/sup 81m/Kr produces heterogeneous images, the activity being proportional to regional ventilation due to rapid decay. Minimal ventilatory delays are detectable. Normal subjects and patients with obstructive lung disease have been evaluated by static equilibrium and dynamic studies. ERA

N77-27701# Oak Ridge National Lab., Tenn.
BIOMEDICAL COMPUTING TECHNOLOGY INFORMATION CENTER: AN INTERNATIONAL RESOURCE FOR TECHNOLOGY SHARING
Betty F. Maskewitz, R. L. Henne (Union Carbide Corp., Oak Ridge, Tenn.), and W. J. McClain (Union Carbide Corp., Oak Ridge, Tenn.) 1976 10 p refs Presented at the IAEA Symp. on Med. Radionuclide Imaging, Los Angeles, 25 Oct. 1976 Sponsored in part by SNM Computer Council and the FDA Bur. of Radiological Health
(Contract W-7405-eng-26)
(IAEA-SM-210/93; Conf-761060-8) Avail: NTIS HC A02/MF A01

The Biomedical Computing Technology Information Center (BCTIC) collects, organizes, evaluates, and disseminates information on computing technology pertinent to biomedicine in general, and nuclear medicine in particular, provides the needed routes of communication between installations, and serves as a clearinghouse for the exchange of biomedical computing software, data, and interface designs. BCTIC services are available to its sponsors and their contractors and to any individual/group willing to participate in mutual exchange. ERA

N77-27702# Argonne National Lab., Ill.
RADIATION CARCINOGENESIS
R. J. Michael Fry 1976 25 p refs Presented at Intern. Conf. on Particles and Radiation Therapy, Berkeley, Calif., 14-17 Sep. 1976
(Contract W-31-109-eng-38)
(CONF-760946-6) Avail: NTIS HC A02/MF A01

The risk of radiation induction of tumors is influenced by the genotype, sex, and age of the patient, the tissues that are exposed, and previous therapy. With chemotherapy the number of cells at risk is usually markedly higher than with radiation therapy. Clearly the problem of the estimation of comparative risks is complex. The current views on the comparative risks, and the importance of the various factors that influence the estimation of risk are presented. ERA

N77-27703# Massachusetts Univ., Amherst.
COMPUTATIONAL TECHNIQUES IN VISUAL SYSTEMS. PART 1: THE OVERALL DESIGN
Michael A. Arbib and Edward M. Riseman Jul. 1976 34 p refs
(Contract N00014-75-C-0459; Grants NSF DCR-75-16098; NS-09755-06)
(AD-A038846; COINS-TR-76-10-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 09/2

The overall goal is to define computational techniques to be used by a system in making a visual scan of a dynamic environment with which it is to interact. Here, both brain mechanisms in the visual systems of animals and humans and computer techniques for the analysis of color photographs of

natural scenes are discussed. Schemes as a formalization of the system's knowledge units are presented. This notion is helpful for our work in both the BT (Brain Theory) and AI (Artificial Intelligence) approaches. Further specific studies--from their group and from elsewhere--of subsystems of both animal and computer visual systems are presented. The interaction of high-level processes with low-level systems, as part of a general emphasis on integrated system design are examined. Part II will focus on techniques for segmenting single static colored images. GRA

N77-27704# Joint Publications Research Service, Arlington, Va.
SPACE BIOLOGY AND AEROSPACE MEDICINE, NO. 3, 1977
7 Jul. 1977 47 p refs Transl. into ENGLISH from Kosm. Biol. i Aviakosm. Med. (USSR), no. 31, 1977 p 3-90
(JPRS-69380) Avail: NTIS HC A03/MF A01

The selection and training of cosmonauts, the evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary flights, and research aimed at guaranteeing safety on long flights and reliability of the human component of the man spaceship system are discussed. Space psychology and physiology, environmental problems and control, including spacecraft habitability and effects of radiation and weightlessness, and telemetry are among the topics considered. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

No abstracts in this category.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N77-27705 Royal Aircraft Establishment, Farnborough (England).
WHOLE BODY VIBRATION: A MECHANICAL AND PHYSIOLOGICAL STUDY OF WORKING POSTURES AND DRIVERS' SEATS
M. Bjurvald, S. Carlsoeoe, J. E. Hansson, and L. Sjoflot 8 Feb. 1977 27 p refs Transl. into ENGLISH of "Helkpoppsvibrationer en teknisk-fysiologisk studie av arbetsstaellningar och foerarstolar", Arbeteoch halsa-vetenskaplig skriftserie no. 7, Stockholm, Arbeter-Skyddsstyreksen, 1973
(RAE-Lib-Trans-1891; BR58186) Copyright. Avail: Issuing Activity

Mechanical and physiological effects of whole body low frequency vibrations have been studied on male subjects in different standing positions and sitting on different seats. The subjects were exposed to sinusoidal vibrations in vertical and lateral directions at frequencies in the range 1.5 to 8.0 Hz and acceleration level of 0.16g (rms) and 0.28g (rms). EMG recordings have shown some characteristic muscle response to the vibration exposure, and increased oxygen uptake and pulmonary ventilation have occurred in the range of the body natural frequency. Acceleration measurements on the head, shoulder, chest and hip have shown characteristic body response for different postures. The seat design is of special importance for the vibration transmission to the body exposed to lateral vibration. Author

N77-27706 Purdue Univ., Lafayette, Ind.
A DYNAMIC INTERACTIVE COMPUTER GRAPHICS PACKAGE FOR HUMAN MOVEMENT STUDIES Ph.D. Thesis
Donald Ray Riley 1976 149 p
Avail: Univ. Microfilms Order No. 77-1766

The system is broken down into three subsystems: data acquisition and management, two-dimensional analysis, and three-dimensional analysis. The two dimensional analysis compute centers of-gravity, linear and angular displacements, velocities and accelerations, and kinetic energies for both the whole body and the individual body segments. The analyses are performed in a PDP 11/40 minicomputer, and the results are displayed on a Tektronix 4014 storage CRT using software. The user is able to interactively select graphs for viewing by positioning the Tektronix crosshairs in the appropriate box of a menu that is displayed on the screen. In addition, graphs may be scaled to any size, superimposed on one another, or arbitrarily positioned on the screen. The three dimensional analysis includes extraction of the third dimension from the two dimensional data obtained using the Graf/Pen. Dissert. Abstr.

N77-27707*# Scientific Translation Service, Santa Barbara, Calif.
SURVEY REPORT OF THE SLEEP TIME ON THE MOSCOW ROUTE
Washington NASA May 1977 38 p Transl. into ENGLISH of "Mosukawa Sen Suimin Jikan Chosa Hokoku", (Tokyo), Oct. 1976 P 1-22
(Contract NASw-2791)
(NASA-TT-F-17530) Avail: NTIS HC A03/MF A01 CSCL 05E

A study is made of fatigue in airline flight crews on the Tokyo-Moscow route. The factors affecting work fatigue are itemized. Author

N77-27708*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A DUAL-LOOP MODEL OF THE HUMAN CONTROLLER IN SINGLE-AXIS TRACKING TASKS
Ronald A. Hess May 1977 55 p refs
(NASA-TM-73249; A-7064) Avail: NTIS HC A04/MF A01 CSCL 05H

A dual loop model of the human controller in single axis compensatory tracking tasks is introduced. This model possesses an inner-loop closure which involves feeding back that portion of the controlled element output rate which is due to control activity. The sensory inputs to the human controller are assumed to be system error and control force. The former is assumed to be sensed via visual, aural, or tactile displays while the latter is assumed to be sensed in kinesthetic fashion. A nonlinear form of the model is briefly discussed. This model is then linearized and parameterized. A set of general adaptive characteristics for the parameterized model is hypothesized. These characteristics describe the manner in which the parameters in the linearized model will vary with such things as display quality. It is demonstrated that the parameterized model can produce controller describing functions which closely approximate those measured in laboratory tracking tasks for a wide variety of controlled elements. Author

N77-27709*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ECLSS CONSUMABLES ANALYSIS: ALT CAPTIVE/ACTIVE 1 AND CAPTIVE/ACTIVE 3
G. J. Steines (McDonnell Douglas Technical Services Co., Inc.) Jun. 1977 36 p refs
(NASA-TM-X-74754; JSC-12913) Avail: NTIS HC A03/MF A01 CSCL 06K

A consumables analysis of the environmental control and life support system (ECLSS) was performed for approach and landing test (ALT) captive/active missions 1 through 3 and is also applicable to missions 4 and 5. The ECLSS configuration analyzed and the guidelines and assumptions used in performing the analysis are presented. A projection of ammonia temperatures and pressures during the captive/active 1 mission is also included. The resulting consumables, budgets are presented in tabular and graphic form. Adequate margins were obtained for all systems. Author

N77-27710*# Virginia Univ., Charlottesville. Dept. of Engineering Science and Systems.
PROCEEDINGS AND FINDINGS OF THE 1976 WORKSHOP ON RIDE QUALITY

A. Robert Kuhlthau, ed. 20 Dec. 1976 86 p refs Proc. held at Fairlee, Vt., 13-15 Oct. 1976 Sponsored by NASA
(Contract DOT-AS-60060)
(NASA-CP-2006; DOT-TST-77-38) Avail: NTIS HC A05/MF A01 CSCL 05H

The workshop was organized around the study of the three basic transfer functions required to evaluate and/or predict passenger acceptance of transportation systems: These are the vehicle, passenger, and value transfer functions. For the purpose of establishing working groups corresponding to the basic transfer functions, it was decided to split the vehicle transfer function into two distinct groups studying surface vehicles and air/marine vehicles, respectively. Author

N77-27711# Sandia Labs., Albuquerque, N. Mex.
DEVELOPMENT OF A HELMET-MOUNTED PLZT THERMAL/FLASH PROTECTION SYSTEM
J. O. Harris, Jr., J. T. Cutchen, and B. J. Pfoff (US Air Force) 1976 10 p refs Presented at 14th Ann. Safe Symp., San Diego, Calif., 13 Sep. 1976
(Contract E(29-1)-789)
(SAND-76-5894; Conf-760976-1) Avail: NTIS HC A02/MF A01

PLZT thermal/flash protective (TFPD's) goggles to prevent exposure and resultant eye damage from nuclear weapon detonations are reported. The primary emphasis of the present program is to transfer technology and establish production capability for helmet-mounted PLZT/TFPD goggles for USAF flight crews, with a non-helmet-mounted configuration to follow. The operating principles of the PLZT/TFPD goggle device are briefly outlined, and the device configuration and operational characteristics are described. ERA

N77-27712# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
WORKING PAPERS IN ACQUISITION OF KNOWLEDGE FOR IMAGE UNDERSTANDING Interim Report
Omer Akin, Raj Reddy, Ronald Ohlander, and Marty Schultz 15 Dec. 1977 60 p refs
(Contract F44628-73-C-0074; AF Proj. 2304)
(AD-A037769; AFOSR-77-0325TR) Avail: NTIS HC A04/MF A01 CSCL 09/2

Use of knowledge has facilitated complex problem solving in many areas of research. However, in the Image Understanding area, we do not have any systematic treatment and codification of knowledge that is useful in image perception. Further, we do not even have adequate tools for acquiring the necessary knowledge base. In this report we present an experimental paradigm for knowledge acquisition, discuss an analysis technique, and illustrate the different types of knowledge that seem to be useful in image understanding research. In the first paper, three major aspects of knowledge are presented: primitive feature extraction operators, rewriting rules, and flow of control. The second paper discusses the picture-puzzle paradigm and the various ways in which it can be used as a tool for acquisition of knowledge. The third paper deals with a computer program that assists the transcription of typical protocols obtained from the picture puzzle tasks. Finally, the last paper of the report discusses the pros and cons of using eye-fixation data to acquire knowledge used in some of the tasks of the picture-puzzle paradigm. The total effort represents an account of the initial results of a new experimental paradigm. We hope that this will provide a sound basis for understanding the issues of knowledge used in visual perception and aid in the modelling of seeing systems. GRA

N77-27713# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
CRITICAL REVIEW AND ANALYSIS OF PERFORMANCE MODELS APPLICABLE TO MANMACHINE SYSTEMS EVALUATION Interim Scientific Report, 1 Oct. 1975 - 30 Sep. 1976
Richard W. Pew, Carl E. Feehrer, Sheldon Baron, and Duncan C. Miller Mar. 1977 306 p refs
(Contract F44620-76-C-0029)
(AD-A038597; BBN-3446; AFOSR-77-0520TR) Avail: NTIS HC A14/MF A01 CSCL 05/8

This report focuses on the review of potentially relevant models and on the identification of issues in model development and application that may have an important impact on models for large-scale, man-machine systems. A detailed and critical evaluation of several classes of human-performance models is presented. Interrelations among existing models are examined, and an evaluation is made on the needs and gaps in the technology. Modelling issues are identified, and research recommendations indicated. Approximately forty models, techniques that have some applicability to the simulation modelling program are abstracted in the Appendix. Author (GRA)

N77-27714# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF USER GENERATED COCKPIT DISCREPANCIES IN NAVAL AIRCRAFT M.S. Thesis
Frederick George Schobert, Jr. Sep. 1976 58 p refs
(AD-A038774) Avail: NTIS HC A04/MF A01 CSCL 01/3

This thesis analyzes problems in current Naval aircraft as reported by fleet aviators attending the U.S. Naval Aviation Safety School. A method is developed which facilitates the collection and processing of the reported information. A collective sample of 286 incidents is stratified into a design discrepancy outline which illuminates 31 specific problem areas. Various recommendations are made concerning concept expansion to a fleet-wide level. Author (GRA)

N77-27715# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
IMPACT TESTS OF A NEAR-PRODUCTION AIR CUSHION RESTRAINT Final Report, Jan. 1972 - Sep. 1975
J. W. Brinkley, G. C. Mohr, H. C. Russell, S. M. Cooper, and J. T. Schaffer Feb. 1977 398 p refs
(Contract DOT-HS-017-1-017-1A)
(PB-265156/0; AMRL-TR-75-47; DOT-HS-802-248) Avail: NTIS HC A17/MF A01 CSCL 13F

A series of impact tests were accomplished to demonstrate the protection provided by an automotive air bag restraint system for the center and right front passengers. Fifteen young healthy male volunteers were impacted at velocities ranging from 14.9 to 30.8 miles per hour. Impact acceleration-time histories approximated automotive barrier crash profiles. The results of dummy tests preceding human testing are summarized and detailed test data are presented from 33 impact tests with volunteer subjects. Test data are compared with similar data collected during earlier impact tests of a prototype air bag restraint system. GRA

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering*.

N77-27716 Purdue Univ., Lafayette, Ind.
A MICROPROGRAMMED MINICOMPUTER FOR THE EFFICIENT EXECUTION OF HIGH-LEVEL LANGUAGE PROGRAMS Ph.D. Thesis
Bradford Warren Wade 1975 188 p
Avail: Univ. Microfilms Order No. 77-1792

A computer architecture implements, in firmware, a set of high-level constructs which are common to a wide variety of programming languages. A base architecture was developed oriented around a single accumulator organization; experimental and analytical justification are presented for this choice. To this base architecture instructions were added which facilitate array-handling, DO-loop control, block structure, input/output editing, and character-string manipulation, plus additional small useful instructions. The high level architecture was implemented by microprogramming a Microdata 1600, a minicomputer featuring a writable control store. The architecture was compared against that of the IBM 360/370 series of machines by compiling and executing several high level language programs under both architectures. Dissert. Abstr.

N77-27717 California Univ., Los Angeles.
RELIABILITY MODELING AND ANALYSIS FOR FAULT-TOLERANT COMPUTERS Ph.D. Thesis
Ying-Wah Ng 1976 243 p
Avail: Univ. Microfilms Order No. 77-1651

Attempts are made to bring unity and simplicity to the field of reliability modeling for fault-tolerant computers by developing it in a unified framework of analysis. Markov modeling techniques are used consistently throughout this work. A general reliability model is developed which is applicable to most fault-tolerant computer architectures that exist. The special case of the general model when applied to closed (nonrepairable) systems yields an efficient procedure for reliability estimation that is highly preferable to those developed in existing equivalent models. In addition, a study of transient fault and transient fault recovery in computer systems is attempted. A model of the transient fault recovery process is studied. Finally, a computer program ARIES is developed for automated reliability analysis. The system is interactive and presents a simple interface to the user. Because of the unified method of reliability analysis that ARIES is based on, it is an efficient and general system. Dissert. Abstr.

N77-27718*# Ohio Univ., Athens. Avionics Engineering Center.
A KEYBOARD INTERFACE FOR THE JOLT MICROPROCESSOR
Lee Wright May 1977 8 p refs
(Grant NGR-36-009-017)
(NASA-CR-152867; TM-50) Avail: NTIS HC A02/MF A01 CSCL 09B

A keyboard interface designed to allow data input without use of a teleprinter is described. In operation, the keyboard allows JOLT start-up and entry of data for LORAN or OMEGA navigation. Author

N77-27719*# Linkabit Corp., San Diego, Calif.
HIGH BIT RATE CONVOLUTIONAL CHANNEL ENCODER/DECODER Final Report
20 Jun. 1977 62 p
(Contract NAS9-14936)
(NASA-CR-151446) Avail: NTIS HC A04/MF A01 CSCL 09B

A detailed description of the design approach and tradeoffs encountered during the development of the 50 MBPS decoder system is presented. A functional analysis of each of the major logical functions is given, and the system's major components are listed. Author

N77-27720*# Ohio Univ., Athens. Dept. of Electrical Engineering.
SIMULATION OF DIGITAL PHASE-LOCKED LOOPS
Paul R. Blasche May 1977 18 p
(Grant NGR-36-009-017)
(NASA-CR-153269; TM-49) Avail: NTIS HC A02/MF A01 CSCL 09B

Simulation equations are developed for first and second order digital phase locked loops. Examples of loop simulation are given to determine loop performance with respect to several loop parameters. Author

N77-27721# California Univ., Livermore. Lawrence Radiation Lab.
USER'S GUIDE TO SURFACE: AN INTERACTIVE PROGRAM FOR CREATING PICTURES AND MOVIES OF THREE-DIMENSIONAL SURFACES
Gary A. Chappell and Lyle A. Cox, Jr. 15 Dec. 1976 28 p
(Contract W-7405-eng-48)
(UCID-17352) Avail: NTIS HC A03/MF A01

In many cases, scientifically important problems cannot be well represented for visual interpretation in two dimensions. For example, in the case of potential energy surfaces, two-dimensional plots are often insufficient. Additionally, the available data in these problems tends to be rather sparse-at least by computer graphics standards. SURFACE is a computer code designed to operate with Livermore Time Sharing System hardware and software. The program's purpose is to facilitate comprehensive analysis through the generation of three-dimensional figures from sparse data sets and the production of a 16- or 35-mm movie of the surface from a wide range of perspectives. ERA

N77-27722# Oak Ridge National Lab., Tenn.
STATISTICAL STUDY OF THE ERRORS IN THE ARITHMETIC OF COMPUTERS; APPLICATION TO THE MONITORING OF THE RESULTS OF NUMERIC ALGORITHMS
M. LaPorte and J. Vignes [1974] 10 p refs Transl. into ENGLISH from Numer. Math., France, vol. 23, 1974 p 63-72 Sponsored by ERDA
(ORNL-TR-4220) Avail: NTIS HC A02/MF A01

Numerical calculations on a digital computer are performed on operands with a limited number of significant digits; therefore, each operator in the computational arithmetic is merely an approximation of the corresponding mathematical operator. Consequently, every numerical operation carried out on a computer generates a numerical error. The statistical evaluation of these errors is discussed. The formulas obtained are used to assess the validity of numerical results obtained in the resolution of linear systems, algebraic equations, and matrix inversion. ERA

N77-27723# Federal COBOL Compiler Testing Service, Washington, D. C.
COBOL COMPILER VALIDATION SUMMARY REPORT. UNIVAC SERIES 70145 USACOB VERSION 011
31 Mar. 1977 26 p
(AD-A037804; CCVS68-VSR185) Avail: NTIS HC A03/MF A01 CSCL 09/2

This Validation Summary Report (VSR) for the UNIVAC Series 70/45 USA, COB, COBOL Compiler Version 011, TDOS Version 23, provides a consolidated summary of the results obtained from the validation of the subject compiler against the 1968 COBOL Standard X3.23-1968/VIPS PUB 21. The compiler was validated at the high level of FIPS PUB 21. The VSR is made up of several sections showing the discrepancies found. These include an overview of the validation which lists all categories of discrepancies by level/module within X3.23-1968, a section relating the categories of discrepancies to each of the Federal levels of the language and a detailed listing of discrepancies together with the tests which were failed. Author (GRA)

N77-27724# Federal COBOL Compiler Testing Service, Washington, D. C.
COBOL COMPILER VALIDATION SUMMARY REPORT
17 Feb. 1977 52 p
(AD-A037141; CCVS74-VSR175) Avail: NTIS HC A04/MF A01 CSCL 09/2

This Validation Summary Report VSR for the Information Processing Incorporated COBOL Compiler Version 2.0 provides a consolidated summary of the results obtained from the validation of the subject compiler against the 1974 COBOL Standard X3.23-1974/FIPS PUB 21-1. The compiler was validated at the low level of FIPS PUB 21-1. The VSR is made up of several sections showing the discrepancies found. These include an overview of the validation which lists all categories of discrepancies by level/module within X3.23-1974, a section relating the categories of discrepancies to each of the Federal levels of the

language and a detailed listing of discrepancies together with the tests which were failed. GRA

N77-27725# Federal COBOL Compiler Testing Service, Washington, D. C.
COBOL COMPILER VALIDATION SUMMARY REPORT
1977 76 p
(AD-A037684; CCVS74-VSR180) Avail: NTIS HC A05/MF A01 CSCL 09/2

The purpose of the Validation Summary Report, VSR is to identify individual COBOL Language elements whose implementation does not conform to Federal Standard COBOL as adopted from American National Standard Programming Language COBOL, X3.23-1974, by federal Information Processing Standard 21-1 FIPS PUB 21-1. GRA

N77-27726# Brown Univ., Providence, R. I.
INTERACTIVE COMPUTER GRAPHICS Annual Report, 1 Jan. - 31 Dec. 1976
Andries VanDam 31 Dec. 1976 8 p refs
(Contracts N00014-75-C-0427; NSF MCS-76-04002)
(AD-A037200) Avail: NTIS HC A02/MF A01 CSCL 09/2

The goal of this research in distributed computing is to evolve fundamental concepts as well as implementation techniques for improving system performance by judicious runtime distribution of functions to processors and to levels of a hierarchical operating system. This optimal distribution of computing tasks among the various processors in a network or among the many levels of a hierarchical operating system in a single computer is a critical issue in current and future industrial, military, and educational computer systems. For example, host/satellite configurations consisting of a large-scale time-shared host computer and a set of small but 'intelligent' mini-computer satellites and networks of heterogeneous mainframe or minicomputer systems, will continue to grow in importance. Our objective is to develop tools for the applications programmer that allow both the estimation of performance improvements of potential migrations, either horizontal Inter-processor or vertical Intra-processor, between layers of the hierarchical system and the implementation of the most promising migrations. Furthermore, the resultant division of labor must represent a cost-effective, reliable use of the selected configuration. Through cycles of design and experimental validation/tuning, expected is the production of tools and results potentially applicable to a range of modern distributed architectures. Author (GRA)

N77-27727# Computer Corp. of America, Cambridge, Mass.
DATACOMPUTER PROJECT Semiannual Technical Report, 1 Jul. - 31 Dec. 1976
31 Dec. 1976 68 p
(Contract MDA903-74-C-0225; ARPA Order 2687)
(AD-A037415) Avail: NTIS HC A04/MF A01 CSCL 09/2

This report describes work which falls into two of the following categories: production operation of Datacomputer Version 1; preparation and release of Datacomputer Version 2, the first version of the Datacomputer to support an Ampex Terabit Memory System; production operation of Version 2; preparation and release of Datacomputer Version 3. GRA

N77-27728# Defense Systems Management School, Fort Belvoir, Va.
GENERAL PURPOSE COMPUTER ACQUISITION
Francis C. Marr Nov. 1976 102 p refs
(AD-A037757) Avail: NTIS HC A06/MF A01 CSCL 09/2

The paper is divided into four major chapters, each of which takes the reader through a series of steps which are essential to the task of evaluating and selecting a computer system. Report concentrates on general purpose commercially available (non-embedded) computers. The inquiry was conducted by means of library research. The emphasis on topic selection is that of the author and is by no means either all-inclusive or exhaustive. The attempt was to review current literature pertaining to ADP acquisition process. Computers are pervasive. Project managers (PM) cannot ignore them. Typical managers prefer to delegate the subject of computers to specialist groups for detailed actions. A manager must be aware of such subjects as benchmarking, simulation, cost-value/scores-weights approach, etc., as they apply to computer evaluation/selection. This paper discusses these aspects and many more. In essence, it serves as an overview of methods in the above subject area, which a PM can use to pick and choose from as his particular rules, regulations, and circumstances permit. Author (GRA)

N77-27729# Inco, Inc., McLean, Va.
TRANSPARENT INTEGRATED INTELLIGENCE NETWORK QUERY INTERMEDIATE PROCESSOR Final Technical Report, 3 Nov. 1975 - 2 Nov. 1976
Paul Stygar, Andrew Puchrik, and Margaret Turek Jan. 1977 182 p refs Revised
(Contract F30602-76-C-0090)
(AD-A037947; RADC-TR-77-39-Rev) Avail: NTIS HC A09/MF A01 CSCL 09/2

This Final Report presents a functional design and preliminary specifications for a query language translator to provide query language transparency in an intelligence network, so that one query language may be used to access data bases which otherwise would be accessed by different query languages. Author (GRA)

N77-27730# Mitre Corp., Bedford, Mass.
COMPUTER PERFORMANCE EVALUATION DURING SYSTEM ACQUISITION
Bruce A. Feldmeyer Jan. 1977 32 p refs
(Contract F19628-77-C-0001)
(AD-A037117; MTR-3290; ESD-TR-76-358) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report discusses the applications of various computer performance evaluation (CPE) tools and techniques such as hardware monitors, software monitors, and computer simulation during the acquisition of Air Force Command, Control and Communications (C cubed) systems. It is intended primarily for analysts concerned with the specification, measurement and evaluation of the performance of the computer resources in these systems. It can be used to augment the software acquisition guidebooks (e. g., Software Verification) and checklists being developed to assist in the review of system acquisition documents. This report does not discuss either performance evaluation per se or the activities, milestones or products during system acquisition. It is assumed that the reader is familiar with these subjects. GRA

N77-27731# Range Commanders Council, White Sands Missile Range, N. Mex. Data Reduction and Computing Group.
TECHNIQUES IN DATA COMPRESSION AND MAXIMIZATION OF INFORMATION CONTENT Final Report
Jan. 1977 143 p refs
(AD-A038015) Avail: NTIS HC A07/MF A01 CSCL 09/2

The expression 'data compression' has broad meaning and may encompass any or all of the following: data compaction, bandwidth compression, redundancy removal, redundancy reduction, adaptive sampling, parameter extraction, optimal estimation, and possibly a few other techniques. In general, data compression denotes operations which are performed to reduce the quantity of data prior to transmission, but which still preserve the minimum data elements of a measurement continuum such that the original information may be reconstructed within established limits of error. This document is intended as a single source document describing available techniques for reducing the quantity of data processed and for providing meaningful presentation. It includes mathematical, statistical, and graphical techniques which have been used successfully. GRA

N77-27732# Honeywell Information Systems, Inc., McLean, Va. Federal System Operations.
SEMI-ANNUAL PROGRESS REPORT, JULY 1975 - DECEMBER 1975
N. Adleman, J. R. Gilson, R. J. Sestak, and R. J. Ziller 31 Jan. 1976 63 p refs
(Contract F19628-74-C-0193)
(AD-A037501; ESD-TR-76-270) Avail: NTIS HC A04/MF A01 CSCL 09/2

The goal of Project Guardian is to design, develop, and certify a secure Multics to provide a certified secure multilevel computer utility. The report covers activites from July to December 1975 with an introductory summary of prior work. Activities reported include simplification of the Multics operating system, development of the Multics security kernel, design of the Secure

Communications Processor (SCOMP) hardware, development of the SCOMP security kernel, methodology for certifying software, and development of ruggedized SCOMP hardware. A list of all documentation produced under the contract during this period is included. Author (GRA)

N77-27733# McDonnell-Douglas Astronautics Co., St. Louis, Mo.

A SURVEY AND ANALYSIS OF MILITARY COMPUTER-BASED SYSTEMS: A TWO PART STUDY. VOLUME 2: A SURVEY AND ANNOTATED BIBLIOGRAPHY OF AIDS FOR INSTRUCTIONAL SYSTEMS DEVELOPMENT Final Report, 1 Oct. 1975 - 11 Feb. 1977

Robert S. Logan 11 Feb. 1977 195 p
(Contract MDA903-76-C-0086; ARPA Order-3076)
(AD-A036912; MDC-E1570-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 09/2

The objectives of this study were: (1) to examine the literature to identify authoring aids for developing instructional materials and to indentify information clearing houses for existing instructional materials; and (2) to develop a generalized, computer-based model of a self-paced instructional system that can be used to determine expected timesaving and costs of self-pacing as compared to conventional instruction. The purpose of Part 1, reported in Volume 1, was to examine the ISD concept as it relates to the authoring process and to identify and analyze tools and procedures which facilitate the ISD process. Findings of the study are: (1) more applied but unevaluated documents are associated with the civilian environments; (2) relatively equal numbers of applied and evaluated documents exist in both the civilian and military environments; (3) a greater number of authoring aids (tools, procedures, and methodologies) tend to be produced by the civilian environment; and (4) more procedures are available than either tools or methodologies. Approximately sixty authoring tools and procedures are arranged by ISD phase and step in an extensive, annotated bibliography. The ISD model used in this study was the Interservice Procedures for Instructional Systems Development (IPISD) Model. The results of Part 2, a computer-based model of self-paced instruction, are reported in Volume 2. Author (GRA)

N77-27734# Stanford Univ., Calif. Digital Systems Lab.

ASYNCHRONOUS SERIAL INTERFACE FOR CONNECTING A PDP-11 TO THE ARPANET (BBN 1822)

Ronald C. Crane Jul. 1976 50 p
(Contract MDA903-76-C-0093; ARPA Order 2494)
(AD-A037212; SU-TR-116) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report describes an interface to permit the connection of any PDP-11 to either the Packet radio network or the ARPAnet. The interface connects to an IMP on one side, meeting the specifications published in BBN report number 1822, and to a 16 bit parallel interface (DRV-11 or DR11-C) as described in the DEC peripherals and interfacing handbook. The interface card itself is a double height board (5.2in.x8.5in.) which can be plugged into any peripheral slot in a PDP-11 backplane. The interface card is connected to the parallel interface card via two cables with Berg 40 pin connectors (DEC H-856) and to the IMP via an Amphenol bayonet connector (48-10R-18-31S). All 3 cables and connectors are supplied with the I/O interface card. The parallel interface card (DEC DR11-C or DRV-11) together with the special I/O interface card described in this report comprise the 1822 interface. The report includes descriptions of the operation of circuits, programming, and diagnostics for the 1822 interface. Author (GRA)

N77-27735# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

A COLLECTED GUIDE TO MICROSYSTEM SELECTION

Thomas Arthur Cole Jan. 1977 242 p refs
(Contract F30602-75-C-0082; AF Proj. 9567)
(AD-A037964; RADC-TR-77-28) Avail: NTIS HC A11/MF A01 CSCL 09/2

Microprocessors, because of their small size, low cost, and versatility, are being considered for use in areas classically unrelated to Electrical Engineering. Thus, many persons untrained in electrical engineering principles must face the problem of microprocessor selection without the necessary background. The report presents a selection algorithm and the basic information required by this algorithm to allow the novice to grasp the concepts required of him during the selection process. In addition, the role of computers in creating a data base, and operating on this data base is discussed. Ideas for future work in the area are generated. Finally, material concerning where to find microsystem vendors, a bibliography of published material on microprocessors, microprocessor descriptions, and a glossary of commonly used terminology is included as appendices. Author (GRA)

N77-27736# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.

A COLLECTION OF PAPERS ON Cm*: A MULTI-MICROPROCESSOR COMPUTER SYSTEM Interim Report

S. H. Fuller, A. K. Jones, D. P. Siewiorek, R. S. Swan, A. Bechtolsheim, R. J. Chansler, I. Durham, P. Feiler, K. W. Lai, and J. Ousterhaut Feb. 1977 38 p refs
(Contract F44620-73-C-0074; Grant NSF GJ-32758)
(AD-A037842; AFOSR-77-0321TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper describes the architecture of a new large multiprocessor computer system being built at Carnegie-Mellon University. The system allows close cooperation between large numbers of inexpensive processors. All processors share access to a single virtual memory address space. There are no arbitrary limits on the number of processors, amount of memory, or communication bandwidth in the system. Considerable support is provided for low level operating system primitives and inter-process communication. Author (GRA)

N77-27737# Naval Ship Research and Development Center, Annapolis, Md. Materials Dept.

A STATE-OF-THE-ART DATA SYSTEM FOR THE EVALUATION OF UNDERWATER ACOUSTIC MATERIALS

Melvin H. Main, Jr. and Keith R. Musson Feb. 1977 22 p
(AD-A036864; MAT-76-81) Avail: NTIS HC A02/MF A01 CSCL 09/2

A computerized data acquisition system intended to completely automate the evaluation of underwater acoustic materials in the environment of a waveguide has been designed by the David W. Taylor Naval Ship Research and Development Center, Annapolis, Maryland. The system utilizes software sampling: a technique whereby the complete time-varying, analog representation of an acoustic signal is converted into digital format by means of a digital oscilloscope and then transferred to a computer where it is processed under program control. Data reduction occurs simultaneously with data acquisition and is obtained in hard-copy format as well as in graphical form. Measurements, such as reflection loss, energy absorption, target strength reduction, and acoustic impedance, are incorporated into the system through software creation and require no additional hardware subsystems. Author (GRA)

N77-27738# Wisconsin Univ., Madison. Mathematics Research Center.

A FORTRAN-TRIPLEX-PRE-COMPILER BASED ON THE AUGMENT PRE-COMPILER

K. Boehmer and R. T. Jackson Mar. 1977 34 p
(Contract DAAG29-75-C-0024)
(AD-A038964; MRC-TSR-1732) Avail: NTIS HC A03/MF A01 CSCL 09/2

Triplex arithmetic is a variation of interval arithmetic in which a main or rounded value is computed in addition to the end-points of the containing interval. The main value may be considered, depending on the application, to be the most probable result of the computation, with the interval bounds indicating the possible error. This paper describes an implementation of Triplex arithmetic in single and multiple precision. The implementation is based on the Augment precompiler to obtain an easily used package. Author (GRA)

N77-27739# Purdue Univ., Lafayette, Ind.

SIGNIFICANT ACCOMPLISHMENTS AND DOCUMENTATION OF THE INTERNATIONAL PURDUE WORKSHOP ON INDUSTRIAL COMPUTER SYSTEMS. PART 4: SOME REPORTS ON THE STATE-OF-THE-ART AND FUNCTIONAL REQUIREMENTS FOR FUTURE APPLICATIONS Final Report, 1 Feb. 1976 - 31 Jan. 1977

Jan. 1977 321 p
(Contract N00014-76-C-0732)
(AD-A038058) Avail: NTIS HC A14/MF A01 CSCL 09/2

This volume represents Part 4 of a six volume set reproducing the major work accomplished during the past eight years. This material is reprinted from the minutes of the several individual meetings of the Workshop and represents the work carried out by the standing committees of the Workshop. GRA

N77-27740# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
EVALUATION OF ALTERNATIVE COMPUTER ARCHITECTURES Interim Report
M. R. Barbacci, ed., W. E. Burr, ed. (Army Electronics Command, Fort Monmouth, N. J.), S. H. Fuller, ed., and D. P. Siewiorek, ed. 12 Feb. 1977 143 p refs
(Contract F44620-73-C-0074; Grant DAAG29-76-G-0299; AF Proj. 2304)
(AD-A038462; AFOSR-77-0381TR) Avail: NTIS HC A07/MF A01 CSCL 09/2

The Computer Family Architecture (CEA) Selection Committee was organized to select a proven, well-known computer architecture, in addition to several widely used military computer architectures, as the basis of the future series of Military Computer Family (MCF) computers. The set of four papers that make up this report provide an overview of the work of the CFA Committee and a detailed discussion of the technical methods used to quantitatively evaluate the alternative computer architectures under consideration. As the first paper describes, support software availability, life cycle costs, and architecture licensing, in addition to architectural efficiency, were considered in the final evaluation process. As a result of this process, the CFA Committee ranked the three architecture finalists in the following order; the DEC PDP-11, the IBM System/370, and the Interdata 8/32. The MCF project is now working on the specification of a new standard architecture for military applications based on the PDP-11. In addition, the MCE project is working on more clearly specifying the most widely used existing military computer architectures to enable future reimplementations of these architectures in new technologies. GRA

N77-27741# National Bureau of Standards, Washington, D. C. Inst. for Computer Science and Technology.
COMPUTER SCIENCE AND TECHNOLOGY: SURVEY OF REMOTE TERMINAL EMULATORS
Shirley Ward Watkins and Marshall D. Abrams Apr. 1977 84 p refs
(PB-265139/6; NBS-SP-500-4) Avail: NTIS HC A05/MF A01 CSCL 09B

This report describes twelve remote terminal emulators (RTE's). The key terminology associated with remote terminal emulation is defined and possible application areas are discussed. Technical implementation details and operational considerations are addressed for each RTE. Summary tables are provided to indicate current RTE capabilities and capacities, as claimed by the RTE developers. GRA

N77-27742# National Bureau of Standards, Washington, D. C. Inst. for Computer Sciences and Technology.
COMPUTER SCIENCE AND TECHNOLOGY: IMPACT OF CHARGE-TRANSFER DEVICE TECHNOLOGY ON COMPUTER SYSTEMS
Robert B. J. Warnar Apr. 1977 52 p refs
(PB-265117/2; NBS-SP-500-5; LC-77-608053) Avail: NTIS HC A04/MF A01 CSCL 09B

An assessment is made of the status of charge transfer device technology as displayed by foreign research and manufacturing facilities for a period up to September 1975. Capabilities and accomplishments of charge-transfer device research facilities in Japan, Canada, Great Britain, The Netherlands, The Federal Republic of Germany, and the United States are described. Technical and economic factors are addressed and compared. Conclusions are presented which suggest future impacts of charge-transfer devices on current electronic systems, especially computers. Information contained in this report was derived from the open technical literature and from interviews with various U.S. technical experts. The technology assessment was conducted as part of an 'Advanced Computer Technology Survey' project. GRA

N77-27743# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
CMU-11 ENGINEERING DOCUMENTATION Interim Report
S. H. Fuller, T. M. McWilliams, and W. H. Sherwood Jan. 1977 50 p refs
(Contract F44620-73-C-0074)
(AD-A038195; AFOSR-77-0320TR) Avail: NTIS MF A01 CSCL 09/2

The CMU-11 is a microprogrammable processor built with the Intel 3000 microcomputer set that emulates the PDP-11 architecture. In addition, it has been designed to provide full Unibus support. The enclosed documentation gives the details of the CMU-11 design. This documentation has been generated in conjunction with the Stanford Drawing System, the SAGE simulator, and the Intel 3000 microassembler. Those hoping to do any further development of the CMU-11 design are encouraged to also use these design aids and all of the CMU-11 design information shown here, and other information such as ROM contents and wirelists, are available on magnetic tape. GRA

N77-27744# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE TERMINAL INTERFACE MESSAGE PROCESSOR PROGRAM Update for TIP Version 410
Feb. 1977 228 p refs Revised
(Contracts DAHC15-69-C-0179; F08606-75-C-0032)
(AD-A038344; Tech Infor-91) Avail: NTIS HC A11/MF A01 CSCL 09/2

Understanding the Terminal IMP software depends on an understanding of the hardware environment in which the software resides. A summary of the Terminal IMP hardware follows. Up to 63 terminals, either remote or local, of widely diverse characteristics may be connected to a given TIP and thereby 'talk' into the network. It is also possible to connect a Host to a TIP in the usual way a Host is connected to an IMP. The TIP is built around a Honeywell H-316 computer with 28 K of core. It embodies a standard 16-port multiplexed memory channel with priority interrupts and includes a Teletype for debugging and program reloading. Other features of the standard IMP also presented are a real-time clock, power-fail and auto-restart mechanism, and a program-generated interrupt feature. As in the standard IMP, interfaces are provided for connecting to high-speed 50-kilobit, 230.4-kilobit, etc. Modems as well as to Hosts. Aside from the additional 12 K of core memory, the primary hardware feature which distinguishes the TIP from a standard IMP is a Multi- Line Controller (MLC) which allows for connection of terminals to the IMP. Any of the MLC lines may go to local terminals or via modems to remote terminals. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N77-27745 Texas A&M Univ., College Station.
A SYSTEM FOR MEASURING PROGRAM COMPLEXITY Ph.D. Thesis
Jean Marie Cochrane Zolnowski 1976 226 p
Avail: Univ. Microfilms Order No. 77-2686

Program's complexity techniques consist of the development of a system which would serve not only as a static analyzer for analyzing a program in terms of its relevant complexity characteristics, but also as a vehicle for actually collecting statistics on each complexity characteristic as it was evidenced in a program. The program statistics collected are analyzed and then utilized in various measures of program complexity. A great number of subjective opinions were put forth on the topic of program complexity. These opinions have proposed a wide range of program characteristics as factors relevant to complexity. Unfortunately, there is little objective validation to reinforce these proposed characteristics as valid in measuring complexity. Dissert. Abstr.

N77-27746 Texas A&M Univ., College Station.
A QUANTITATIVE ANALYSIS OF ESTIMATING ACCURACY IN SOFTWARE DEVELOPMENT Ph.D. Thesis
Philip Francis Gehring, Jr. 1976 190 p
Avail: Univ. Microfilms Order No. 77-2622

This research quantitatively examines the estimating accuracy of over 5,000 standardized resource consuming activities from 39 software development projects of various size which were accomplished at the U.S. Air Force Data Systems Design Center. The activity data pertaining to planned hour estimates and actual expenditures were collected by an automated project management system (PARMIS) as the data were generated. It is hypothesized that specific activities can be isolated which consistently have a greater influence on whether a software development project will be successful in terms of cost and schedule estimates. The arithmetic and percent differences between estimated and observed hour expenditures are the elementary variables used to investigate estimating accuracy.
Dissert. Abstr.

N77-27747 Colorado Univ., Boulder.
TEST DATA GENERATION AND SYMBOLIC EXECUTION OF PROGRAMS AS AN AID TO PROGRAM VALIDATION Ph.D. Thesis
Lori A. Clarke 1976 151 p
Avail: Univ. Microfilms Order No. 77-3172

An introduction is given where the needs for program testing aids are considered and the goals of this testing system described. The limitations of an automated testing system and how these limitations affect the general system philosophy and expectations are examined. The system is described and some examples are given; also described are the system's problem areas, and alternatives methods are considered. Test results from using the system to analyze numeric programs are presented, and results on the structural properties of programs, the feasibility of generating test data, and the overall effectiveness of the system are considered. The strengths and weaknesses of the system, as well as several suggestions for future research are discussed.
Dissert. Abstr.

N77-27748 Arizona Univ., Tucson.
PROCEDURE-BASED LINGUISTIC MECHANISMS IN PROGRAMMING LANGUAGES Ph.D. Thesis
David Roy Hanson 1976 166 p
Avail: Univ. Microfilms Order No. 77-2308

Most languages provide facilities for the realization of procedural and data abstractions. Described is a procedural approach to the design and implementation of advanced programming language facilities for realizing these kinds of abstractions. The proposed facilities are included as a part of the SL5 programming language. SL5 provides an integrated procedure mechanisn that permits procedures to be used as recursive functions or coroutines. SL5 also permits the programmer to attach a procedural component to a variable that can be used to filter values assigned to the variable or to filter the value of the variable whenever it is fetched. The filter facility is the basis for the inclusion of such features as tracing, dynamic datatype checking, and dynamic protection schemes at the source-language level. Most importantly, filters are used for argument binding permitting the programmer to define various methods of argument transmission in SL5 itself. Dissert. Abstr.

N77-27749 California Univ., Los Angeles.
A SIMULATION LANGUAGE FOR ENVIRONMENTAL SYSTEMS Ph.D. Thesis
Chok Man Lam 1976 284 p
Avail: Univ. Microfilms Order No. 77-1642

A regional approach is introduced to the modeling of environmental systems. A field is first subdivided into regions of similar properties. In each region, the field parameters and excitations are separately specified, and the grid spacing and time step are selected as justified. This method is shown to be stable and convergent. PDEL (Partial Differential Equation Language) is extended so as to make it a useful tool for the modeling of environmental systems. The language provides the facilities for the efficient and convenient representation of region specification, irregular boundaries, nonuniform parameters, excitations and initial conditions. The language is applied to the modeling of a groundwater reservoir of San Fernando Valley in California.
Dissert. Abstr.

N77-27750*# M&S Computing, Inc., Huntsville, Ala.
PAYLOAD SOFTWARE TECHNOLOGY: SOFTWARE TECHNOLOGY DEVELOPMENT PLAN
22 Jun. 1977 133 p
(Contract NAS8-32047)
(NASA-CR-150143; Rept-77-048) Avail: NTIS HC A07/MF A01 CSCL 09B

Programmatic requirements for the advancement of software technology are identified for meeting the space flight requirements in the 1980 to 1990 time period. The development items are described, and software technology item derivation worksheets are presented along with the cost/time/priority assessments.
F.O.S.

N77-27751*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER PROGRAM FOR FLAT SECTOR THRUST BEARING PERFORMANCE
Alden F. Presler and Izhak Etsion Jun. 1977 74 p refs
(NASA-TM-73595; E-8930) Avail: NTIS HC A04/MF A01 CSCL 09B

A versatile computer program is presented which achieves a rapid, numerical solution of the Reynolds equation for a flat sector thrust pad bearing with either compressible or liquid lubricants. Program input includes a range in values of the geometric and operating parameters of the sector bearing. Performance characteristics are obtained from the calculated bearing pressure distribution. These are the load capacity, center of pressure coordinates, frictional energy dissipation, and flow rates of liquid lubricant across the bearing edges. Two sample problems are described.
Author

N77-27752# Washington Univ., Seattle. Dept. of Electrical Engineering.
MODEL VALIDATION USING TIME AND FREQUENCY DOMAIN ERROR MEASURES
M. J. Damborg and L. F. Fuller Sep. 1976 79 p refs
(Contract E(45-1)-1830)
(ERDA-76-152) Avail: NTIS HC A05/MF A01

The development of a package of software which will provide scalar measures of the agreement of dynamic computer simulation models with actual systems is described. The software is designed for interactive use on a graphics terminal once sample system and model trajectories are in memory files. Hence, the software can be applied to any sequences regardless of origin. Six measures of the integral or supremum type are provided. Fourier transform and digital filtering capability are also provided so these scalar measures can be computed for either the time or frequency domain signals or on these signals when restricted to various frequency bands.
ERA

N77-27753# Los Alamos Scientific Lab., N. Mex.
ESECT/EMAP: MAPPING ALGORITHM FOR COMPUTING INTERSECTION VOLUMES OF OVERLAID MESHES IN CYLINDRICAL GEOMETRY
B. R. Wienke and R. D. ODell Dec. 1976 27 p
(Contract W-7405-eng-36)
(LA-6627-MS) Avail: NTIS HC A03/MF A01

Subroutines (ESECT and EMAP) which provide a computer algorithm for mapping arbitrary meshes onto rectangular meshes in cylindrical (r,z) geometry are described. Input consists of the lines defining the rectangular mesh and the coordinates of the arbitrary mesh, which are assumed to be joined by straight lines. Output consists of the intersection volumes with designation of common mesh zones. The ESECT and EMAP routines do not comprise a free-standing code but, instead, are intended for inclusion in existing codes for which one mesh structure (typically Lagrangian) needs to be mapped onto an Eulerian mesh. Such mappings are of interest in coupled hydrodynamic and neutronic calculations.
ERA

N77-27754# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. National Engineering Lab.
SRTPRN: A PROGRAM TO SORT AND PRUNE FAULT TREE CUT SETS

Cynthia A. Dolan Dec. 1976 61 p refs
(Contract EY-76-C-07-1570)
(TREE-1012) Avail: NTIS HC A04/MF A01

SRTPRN is a computer program which sorts fault tree cut sets into groups according to their importance. If desired, it also discards groups of unimportant cut sets and thus prunes the fault tree they represent. The program output includes an ordered list of cut sets retained, a list of the components or failure events represented in these cut sets, and a list of the cut sets deleted, if any. ERA

N77-27755# Maryland Univ., College Park. Dept. of Physics and Astronomy.
EXPERIMENT 2-B DATA PROCESSING SYSTEM
H. Price and F. Svrcek Aug. 1976 106 p
(Contract E(40-1)-2504)
(ORO-2504-245) Avail: NTIS HC A06/MF A01

A new set of programs was written for the analysis of data from the Fermilab 30-inch bubble chamber-wide gap spark chamber hybrid system. Those programs, operating instructions, and how they fit into the overall data flow are described. ERA

N77-27756# Los Alamos Scientific Lab., N. Mex.
SYNOPSIS OF DATA TYPE ABSTRACTION IN PROGRAMMING LANGUAGES
James B. Morris 1976 24 p refs Presented at Very High Level Programming Languages Conf., Moscow, 6-9 Sep. 1976; sponsored by NSF
(Contract W-7405-eng-36)
(LA-UR-76-1750; Conf-760965-1) Avail: NTIS HC A02/MF A01

The concept of an abstract data type is available in the model programming language as a proposed improvement to current ideas of programming methodology. In structured programming the principal technique is refinement of procedures. In Model, the analog is refinement of data types. An abstract data type consists of a data structure and an associated set of operations. The characteristics and suggested uses for this mechanism are discussed. Abstract data types in Model are contrasted with abstract data type mechanisms in the CLU and ALPHARD programming languages. ERA

N77-27757# Sandia Labs., Albuquerque, N. Mex.
USER'S MANUAL FOR PROGRAMS FILXYZ AND FUNXYZ
E. D. Holbrook Feb. 1977 28 p ref
(Contract EY-76-C-04-0789)
(SAND-76-8065) Avail: NTIS HC A03/MF A01

Program FILXYZ prepares an input file for program FUNXYZ by merging together subfiles of data for a specified test configuration or set of test conditions based upon one, two, or three independent variables. Program FUNXYZ computes the function of one, two, or three variables of a set of empirical or test data to provide a file with values that are equally spaced over the independent variables. The programs are written in FORTRAN for use on the CDC 6600. ERA

N77-27758# Sandia Labs., Albuquerque, N. Mex.
USER/PROGRAMMER GUIDE FOR UCMD 63 SAVING AND RESTORING AGS USERS
William C. Burd Feb. 1977 18 p refs
(Contract EY-76-C-04-0789)
(SAND-77-0135) Avail: NTIS HC A02/MF A01

The Applicon Graphic system provides the capability to create and delete users. Whenever a file structure reinitialization is performed, all of the users must be recreated. A computer program is presented which allows users definitions to be copied from an existing system onto magnetic tape. After a file structure reinitialization, the tape can be used as input to recreate the saved users. The program contains an option for deleting users by inspection. ERA

N77-27759# California Univ., Livermore. Lawrence Livermore Lab.
ANALYSIS OF THE RECURSIVE DOUBLING ALGORITHM
Paul F. Dubois and Garry H. Rodrigue Dec. 1976 23 p refs Presented at the Symp. on High Speed Computer and Algorithm Organ., Urbana, Ill., 13-15 Apr. 1977
(Contract W-7405-eng-48)
(UCRL-79071) Avail: NTIS HC A02/MF A01

A mathematical explanation of Stone's algorithms which shows that they are two cases of a general algorithm is presented. A definition is given to the causes of numerical instability in the algorithm, and possible approaches to scaling are suggested. Particular applications are given to solving m term linear recurrence relations, tridiagonal systems of equations and the symmetric tridiagonal eigenvalue problem. For solving a tridiagonal system of equations, the special case where the systems arise from operator splitting techniques for solving parabolic partial differential equations is also considered. It is shown that recursive doubling can become a viable competitor to Gauss Elimination. Author (ERA)

N77-27760# Los Alamos Scientific Lab., N. Mex.
SELF-PATCHING FIRMWARE PROGRAM
Luciano Stanchi Dec. 1976 9 p refs
(Contract W-7405-eng-36)
(LA-6634-MS) Avail: NTIS HC A02/MF A01

A method of branching to an auxiliary program without any hardware or software modification at the time the auxiliary program written is described. The main program is stored as firmware in PROM memory, while the auxiliary program is loaded into RAM memory. The method is described for the Intel 8080 microprocessor, but can be generalized for any microprocessor or minicomputer that uses ROMs or PROMs. ERA

N77-27761# Argonne National Lab., Ill.
OVERVIEW OF MINPACK
Michael Minkoff 1976 9 p refs Presented at Joint Conf. of the Am. Sect. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Can., Inc., Winnipeg, Canada, 15 Aug. 1976
(Contract W-31-109-eng-38)
(CONF-760842-19) Avail: NTIS HC A02/MF A01

The status and some possible future plans of the MINPACK project under development at the Applied Mathematics Division of Argonne National Laboratory are described. The need for developing a nonlinear optimization package arose in connection with revising the nonlinear optimization routines in the local computer library, and work in ERDA on the mathematical optimization of economic and energy models. The MINPACK project is a software project in areas related to mathematical optimization and has aspects dealing with the development and evaluation of algorithms, refinement of available implementations of existing algorithms, development of software implementing algorithms, and applications of these techniques to ERDA-related projects. A general overview of MINPACK and some of its current directions is given. ERA

N77-27762# Language Evaluation Coordinating Committee.
REPORT TO THE HIGH ORDER LANGUAGE WORKING GROUP (HOLWG), EXECUTIVE SUMMARY
Serafino Amoroso (ECOM, Ft. Monmouth, N. J.) and Peter Wagner (Brown Univ., Providence, R. I.) 14 Jan. 1977 87 p
(AD-A037635) Avail: NTIS HC A05/MF A01 CSCL 09/2

The objectives of the language evaluation coordinating committee are to evaluate, summarize, and structure the findings of the language evaluation reports. In this executive summary, the essentials of these findings are presented. Among all the languages considered none was found that satisfies the requirements so well that it could be adopted as the Common Language. GRA

N77-27763# Language Evaluation Coordinating Committee.
REPORT TO THE HIGH ORDER LANGUAGE WORKING GROUP (HOLWG)
Serafino Amoroso (ECOM, Ft. Monmouth, N. J.) and Peter Wagner (Brown Univ., Providence, R. I.) 14 Jan. 1977 2617 p refs
(AD-A037634) Avail: NTIS MF A01 CSCL 09/2

The high costs for software for systems developed within the Department of Defense are receiving increased attention from the highest levels of management. The major part of these costs is for software for what are called 'embedded computer systems.' Such systems would include tactical weapon systems, command and control systems, avionics systems, etc. As part of the overall process of investigating the costs of software, in January 1975 a High Order Language Working Group (HOLWG) was chartered by the Department of Defense with representatives from

the three services. The purpose of this group is to investigate the requirements and specifications for programming languages for embedded computer applications and to recommend the adoption or implementation of the necessary language or languages to achieve an appropriate degree of commonality of programming language usage in the services. GRA

N77-27764# Softech, Inc., Waltham, Mass.
EVALUATION OF ALGOL 68, JOVIAL J3B, PASCAL, SIMULA 67 AND TACPOL VERSUS TINMAN REQUIREMENTS FOR A COMMON HIGH ORDER PROGRAMMING LANGUAGE
Oct. 1976 169 p
(Contract DAAB07-75-C-0373)
(AD-A037637; Rept-1021-14) Avail: NTIS HC A08/MF A01 CSCL 09/2

This report evaluates how well ALGOL 68, JOVIAL J3B, PASCAL, SIMULA 67, and TACPOL satisfy the Department of Defense requirements for high order computer programming languages, as described in A Common Programming Language for the Department of Defense -- Background and Technical Requirements, Institute for Defense Analyses, Arlington, Va., Paper P-1191, June 1976, known informally as the TINMAN. The body of this evaluation report consists of stating for each TINMAN requirement (e.g., A6. Arrays) the degree to which each language satisfies the requirement (e.g., Not Satisfied), together with a justification for this evaluation, keyed to language reference documents. Bibliographic references to these documents are found at the beginning of Section 2, where each language's deficiencies are summarized. The remainder of Section 2 consists of the detailed language evaluations. Each evaluation begins by quoting relevant parts of the TINMAN requirement, and then each language is evaluated separately with respect to that requirement. GRA

N77-27765# RLG Associates, Inc., Reston, Va.
EVALUATION OF CORAL 66, PASCAL, CS-4, TACPOL, CMS-2
18 Nov. 1976 185 p
(AD-A037636) Avail: NTIS HC A09/MF A01 CSCL 09/2
For abstract, see N77-27764.

N77-27766# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DEVELOPMENT OF A NEW ICES EXECUTIVE FOR THE IBM/370 CMS AND VS OPERATING SYSTEMS
Betsy Schumacker 11 Jan. 1977 69 p refs
(Contract F19628-76-C-0002)
(AD-A037487; TN-1977-1; ESD-TR-77-27) Avail: NTIS HC A04/MF A01 CSCL 09/2

A new ICES executive was developed for the IBM/370 to provide more flexibility for engineering use via on-line and background computing environments and also to provide ease of maintainability and improve further development. Input can be prepared and checked (Syntactically and graphically) in an on-line mode, small analyses run and checked on-line, large analyses run in batch mode, and results checked graphically on-line. Two new versions of ICES exist: an on-line (CMS) version and a batch (VS) version. The source, except for a few programs, is independent of the version. This report describes the changes made, the reasons for the changes, new commands developed for on-line use, and performance comparisons with the previous M.I.T. version of ICES. Author (GRA)

N77-27767# Mitre Corp., McLean, Va.
SOFTWARE ACQUISITION MANAGEMENT GUIDEBOOK: LIFE CYCLE EVENTS
J. B. Glore Mar. 1977 72 p refs
(Contract F19628-77-C-0001)
(AD-A037115; MTR-3355; ESD-TR-77-22) Avail: NTIS HC A04/MF A01 CSCL 09/2

This report is one of a series of guidebooks for software acquisition management. The guidebooks are being prepared for use by Air Force Program Office personnel responsible for planning and managing the development of software. This guidebook explains the Major Defense System Acquisition Life Cycle and the Computer Program Life Cycle as they apply to Electronic Systems that include software. Author (GRA)

N77-27768# Naval Ship Research and Development Center, Bethesda, Md. Computation Mathematics/Logistics Dept.
RESULTS OF SURVEY ON USE OF DTNSRDC FORTRAN LIBRARIES
L. Kenton Meals Jul. 1976 22 p
(AD-A037177; CMD-09-76) Avail: NTIS HC A02/MF A01 CSCL 09/2

Use of the FORTRAN subroutine libraries at DTNSRDC was surveyed to determine to what extent the leased proprietary libraries were being used, to get user reaction to a proposed automated subroutine information system, and to discover any other information that might lead to improved library service. In general the leased libraries are most heavily used, reaction to the information system is favorable, and the existing library service is acceptable. Author (GRA)

N77-27769# Naval Ship Research and Development Center, Bethesda, Md.
GIVENS: AN OUT-OF-CORE EIGENSYSTEM SUBROUTINE FOR LARGE ORDER SYMMETRIC MATRICES
Donald A. Gignac Feb. 1977 22 p refs
(AD-A037900; DTNSRDC-77-0025) Avail: NTIS HC A02/MF A01 CSCL 09/2

The need to compute eigenvalues and eigenvectors for large order symmetric matrices arises frequently in the finite element approach to static structural analysis as well as in the applied work of many other fields in the Navy's varied research program. GIVENS is an out-of-core FORTRAN callable eigen-system subroutine which computes all the eigenvalues and specified eigenvectors for a large order real symmetric matrix using modifications of the GIVENS tridiagonalization procedure, the QR method of Francis, and inverse iteration. Author (GRA)

N77-27770# RAND Corp., Santa Monica, Calif.
A REGRESSION PROGRAM FOR LIMITED DEPENDENT VARIABLES
Charles E. Phelps Jul. 1976 24 p refs
(AD-A037894; P-5696) Avail: NTIS HC A02/MF A01 CSCL 09/2

LIMDEP (Version Phelps) is a FORTRAN IV System 370 program for performing regressions using the limited dependent variable technique. The program is wholly double precision, although each observation is read in as a single precision vector, thus permitting the use of F and E formats. Provision is made in the program for performing regressions with the observations weighted. Weights are automatically normalized. Data may be supplied either on cards or on tape or disk input. GRA

N77-27771# System Development Corp., Santa Monica, Calif.
SOFTWARE DATA COLLECTION STUDY: PROCEEDINGS OF THE DATA COLLECTION PROBLEM CONFERENCE
N. E. Willmorth Griffiss AFB, N. Y. RADC Dec. 1976 24 p Conf. held at Santa Monica, Calif., 9 Dec. 1975
(Contract F30602-75-C-0248)
(AD-A037301; SDC-TM-5542/006/01; RADC-TR-76-329-Vol-6) Avail: NTIS HC A02/MF A01 CSCL 09/2

A conference was held in December 1975 to discuss the problems of software data collection. Participants were SDC contract personnel associated with one of three software data repositories and the military, civil service, and contract personnel owning or managing these repositories. The repositories included the proposed RADC Software Data Repository, the Space and Missiles Systems Organization's Satellite Control Facility Computer Program Development Library, and the Army Ballistic Missiles Division's Advanced Technology Center Quantitative Data Base. Each repository presented its objectives and described the data collection problems they have encountered. A general discussion of data collection problems ensued, centering around standardization, the reluctance to release sensitive data, and the bias and subjectivity of project reports. No real solutions to the problems were forthcoming but participants left the conference with a better appreciation of the problem.
Author (GRA)

N77-27772# Computer Sciences Corp., Falls Church, Va.
DOD PROGRAM FOR SOFTWARE COMMONALITY HIGH ORDER LANGUAGE WORKING GROUP
1977 400 p

(Contract N00039-75-C-0289)
(AD-A037640) Avail: NTIS HC A17/MF A01 CSCL 09/2

The Department of Defense (DoD) High Order Language (HOL) Program has as a primary objective to establish a minimum number of HOLs for use throughout DoD. This volume, containing comparisons of: CMS-2, CORAL 66, CS-4, EUCLID, JOVIAL J3B, JOVIAL J73, PEARL, SPL/1 against the DoD language requirements document Tinman, represents Computer Sciences Corporation's contribution to DoD's goal. GRA

N77-27773# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.

THE VALUE FUNCTION OF A MIXED INTEGER PROGRAM, 2

C. E. Blair and R. G. Jeroslow Dec. 1976 30 p refs
(Contract N00014-75-C-0621; Grant NSF GP-37510-X1)
(AD-A036860; RR-397) Avail: NTIS HC A03/MF A01 CSCL 12/2

It is proved that the gap in optimal value, between a mixed-integer program in rationals and its corresponding linear programming relaxation, is bounded as the right-hand-side is varied. In addition, a variant of value iteration is shown to construct subadditive functions which resolve a pure-integer program when no dual degeneracy occurs. These subadditive functions provide solutions to subadditive dual programs for integer programs which are given here, and for which the values of primal and dual problems are equal. GRA

N77-27774# Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.

AN EVALUATION OF PROCESS AND EXPERIMENT AUTOMATION REALTIME LANGUAGE (PEARL)

J. H. Williams Jan. 1977 18 p refs
(AD-A037641) Avail: NTIS HC A02/MF A01 CSCL 09/2

All of the information about PEARL which is used in this report was obtained from the PEARL Language Description (ESG-76). Work on PEARL (Process and Experiment Automation Realtime Language) was begun in 1968. The language was designed to provide systems engineers with a high level means of specifying programs for embedded applications. For that reason it emphasizes the areas of input-output specification and realtime processing and avoids many of the more complex and powerful constructs and capabilities of high level programming languages. In this latter, algorithmic aspect it has the appearance of a severely restricted dialect of PL/I. It is the conclusion of this report that PEARL is not a viable candidate for the DoD common programming language effort, but that the experience gained from its unique approach to input-output specification and realtime control should prove valuable to the forthcoming design efforts. GRA

N77-27775# Carnegie-Mellon Univ., Pittsburgh, Pa.

ABSTRACTION AND VERIFICATION IN ALPHARD: A SYMBOL TABLE EXAMPLE Interim Report

Ralph L. London (USC Information Sciences Inst.), Mary Shaw, and Wm. A. Wulf 29 Dec. 1976 33 p refs
(Contracts NSF DCR-74-04187; AF Proj. 2304)
(AD-A037768; AFOSR-77-0324TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

The design of the ALPHARD programming language has been strongly influenced by ideas from the areas of programming methodology and formal program verification. In this paper we designed, implemented, and verified a general symbol table mechanism. This example is rich enough to allow to illustrate the use as well as the definition of programmer-defined abstractions. The verification illustrates the power of the form to simplify proofs by providing strong specifications of such abstractions. Author (GRA)

N77-27776# Carnegie-Mellon Univ., Pittsburgh, Pa.

PRODUCTION SYSTEMS AS A PROGRAMMING LANGUAGE FOR ARTIFICIAL INTELLIGENCE APPLICATIONS, VOLUME 1 Ph.D. Thesis. Interim Report

Michael D. Rychener Dec. 1976 156 p refs
(Contract F44620-73-C-0074)
(AD-A037843; AFOSR-77-0330TR-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 09/2

This thesis develops a system architecture for artificial intelligence (AI), called production systems (PSs). Each production is a simple condition-action rule, with conditions stated on a global working memory and actions consisting primarily of simple modifications to that memory. Actions can also consist of forming new productions. PSs have been applied to a limited extent in computer science and to a somewhat larger extent to specialized studies in AI. Evaluations of PSs as a programming language are made according to the traits: practical feasibility, style, degree of theory-boundness, power and overhead of expression, productivity, efficiency, architectural flexibility, and level. PSs are found to be effective and advantageous for the programming constructs typical of AI systems. GRA

N77-27777# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.

HYDRA BASIC KERNEL REFERENCE MANUAL Interim Report

Ellis Cohen, Bill Corwin, Dave Jefferson, Tom Lane, and Roy Levin 4 Nov. 1976 84 p refs
(Contract F44620-73-C-0074)
(AD-A037767; AFOSR-77-0323TR) Avail: NTIS HC A05/MF A01 CSCL 09/2

This document is a reference manual for the Hydra Kernel. It contains a minimal amount of tutorial information. Readers who are not familiar with the ideas behind the capability-based protection systems so vital to Hydra are encouraged to read first the Hydra article in the CACM WU74, and the collection of papers given at the Fifth Symposium on Operating Systems Principles, particularly the paper by Cohen COH75. There is a default user environment, consisting of the Hydra Kernel and a collection of subsystems, that a user initially faces when he logs on to Hydra. Hydra is thus a software virtual machine implemented on C.mmp, a closely-coupled PDP-11-based multiprocessor. The extended virtual machine instructions, i.e. those not provided by the underlying hardware but by Hydra, are called K-calls, or Kernel calls. GRA

N77-27778# Army Materials and Mechanics Research Center, Watertown, Mass.

COMPUTER PROGRAMS FOR AUTOMATION OF TWO SMALL-ANGLE X-RAY SCATTERING DIFFRACTOMETERS Final Report

C. Richard Desper Nov. 1976 30 p ref
(AD-A036865; AAMRC-TR-76-38) Avail: NTIS HC A03/MF A01 CSCL 09/2

SPASTIC 76 is an update of previously reported programs written for a minicomputer to permit data acquisition with a small-angle X-ray diffractometer. SPASTIC denotes System for Programming Angles, Scaler, and Timer by Internal Counting, and indicates the general approach used for automation, involving a simple interface and stepping motor control. The present programs are written for two diffractometers of the Bonse-Hart and the Kratky designs, and run on a PDP-8L computer with 8,192 words of core memory. The various programs include routines for finding the zero position and integral breadth of the primary beam, and for step-scanning through the scattering regions. The latter routine incorporates integrations for the Porod invariant. Author (GRA)

N77-27779# Polytechnic Inst. of New York, Brooklyn. Dept. of Electrical Engineering and Electrophysics.

SOFTWARE MODELING STUDIES Summary of Technical Progress, Interim Report, 1 Jan. - 30 Jun. 1976

Griffiss AFB, N. Y. RADC Jan. 1977 33 p refs
(Contract F30602-74-C-0294)
(AD-A036721; POLY-EE/EP-76-013; RADC-TR-76-405) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report presents the progress of this research. Subjects of investigation were error generation and seeding/tagging models, measures for the evaluation of software, analytical data selection methods for program testing, modular programming techniques, methods for finding feasible program paths, statistical program testing and proving, and methods for automatically testing every program path. Work has been completed on development of error generation/manpower deployment models to describe the error correction process in terms of error generation and correction rates as well as the number of man-months spent in

debugging. Work has also been completed in the development of seeding/tagging techniques to estimate the number of software errors and related statistical quantities; measures for comparing programs, such as accessibility, testability, and testedness, based on defining a program as a set of executible modules; and a method for selecting test data sets for a program based on determining the interrelationships among program variables. Work still in progress includes development of techniques to interactively write programs using stored library modules and/or user supplied code, investigation of a satisfactory algorithm to estimate the number of feasible paths in a program, development of a statistical theory for program testing and proving based on using a strategy of both testing and journal proving using Black's model, and implementation of a PL/1 driver to automatically test every possible path and catch errors of any PL/1 program, subject to some minor constraints. GRA

N77-27780# New Jersey Inst. of Technology, Newark.
AN IMPROVED DIRECT SEARCH NUMERICAL OPTIMIZATION PROCEDURE Interim Report
Michael Pappas Feb. 1977 60 p refs
(Contract N00014-75-C-0987)
(AD-A037019; NJIT-NV-10) Avail: NTIS HC A04/MF A01 CSCL 12/1

An improved, nonlinear, constrained mathematical programming optimization algorithm coupling a rotating coordinate pattern search with a feasible direction finding procedure used at points of pattern search termination is presented. The procedure is compared with nineteen popular algorithms, on ten test problems in which the majority of codes failed at least 50% of the time. Only the new method solved all problems, particularly in the case of constrained problems where it was best. Author (GRA)

N77-27781# Army Training Support Activity, Fort Gordon, Ga. Computerized Training Systems Directorate.
PROJECT ABACUS HANDBOOK ON PROGRAM DOCUMENTATION AND DEBUGGING
William L. Ducan 16 Feb. 1976 16 p refs
(AD-A034439; CTSD-TR-76-1) Avail: NTIS HC A02/MF A01 CSCL 09/2

Two of the most important elements of a computer programming effort are program debugging and documentation. This report provides an outline of fundamental debugging techniques to be used by Project ABACUS programmers. These are proven techniques that have been developed through experience. Documentation guidelines, based on US Army Regulations, have been established in this report to provide the programmers with standards for program documentation. The development of standardized procedures and thorough program documentation will enable succeeding programmers to assume responsibility for program maintenance expeditiously and with a minimum of confusion. GRA

N77-27782# California Univ., Berkeley. Electronics Research Lab.
BIBLIOGRAPHY ON NUMERICAL SOFTWARE
Bo Einarsson 25 Mar. 1977 127 p
(Contract N00014-76-C-0013)
(AD-A038827; UCB/ERL-M77/19) Avail: NTIS HC A07/MF A01 CSCL 09/2

This bibliography has been written at the request of the IFIP Working Group on Numerical Software (IFIP WG 2.5), and is intended to serve both members of the working group and others intent on improving numerical software. It has been divided into twenty-one different areas. Within each area the references are given in alphabetical order by the first author. Some references occur in two or at most three areas. This is especially true for the individual articles in the books of Section 2. For some entries a summary is included; either the original abstract, or a shortened form of the original, or a summary written by the present author. The aim of the bibliography is to be useful in the production and evaluation of good software for numerical mathematics. However, it does not include references to algorithms in the numerical analysis literature, nor does it include references to individual software products (routines). Section 7 on bibliographies includes many entries not strictly within the scope of the present work. GRA

N77-27783# Pattern Analysis and Recognition Corp., Rome, N. Y.
IMAGE PROCESSING SOFTWARE CONVERSION. USERS MANUAL AND TECHNICAL REPORT Final Technical Report, Jan. - Dec. 1976
John C. Lietz, Michael J. Gillotte, and Donald R. House Griffiss AFB, N. Y. RADC Feb. 1977 149 p 2 Vol.
(Contract F30602-76-C-0164)
(AD-A038136; PAR-76-35-Vol-1; RADC-TR-77-51-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 09/2

Interactive, on-line image processing has experienced an expanding interest in many areas of application. As a result, a number of systems based on this approach have been developed in recent years. A pioneer in this area has been the image processing system at RADC which has evolved into a very powerful and comprehensive system. This system came about as a result of separate but coordinated efforts in related areas of image processing. Due to a continuing requirement for its capabilities, it is currently being updated to execute on a more recent and powerful processor. This document is the final report describing the effort by Pattern Analysis and Recognition PAR Corporation to convert a portion of the RADC image processing software to allow execution on a DEC PDP 11/45 processor. A section of this report is written in the form of a user's manual for personnel engaged in the operation of the converted software. A companion document contains the detailed system design, the individual program descriptions, and a programmer's manual which describes how new options may be written and incorporated into the system. Author (GRA)

N77-27784# Pattern Analysis and Recognition Corp., Rome, N. Y.
IMAGE PROCESSING SOFTWARE CONVERSION. COMPUTER PROGRAM DOCUMENTATION AND COMPUTER PROGRAMMING MANUAL Final Technical Report, Jan. - Dec. 1976
John C. Lietz, Michael J. Gillotte, and Donald R. House Griffiss AFB, N. Y. RADC Feb. 1977 218 p 2 Vol.
(Contract F30602-76-C-0164)
(AD-A038137; PAR-76-35-Vol-2; RADC-TR-77-51-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 09/2

This report describes the software design of the portion of the RADC image processing system that has been converted to execute on a PDP 11/45 computer. Certain changes in the design philosophy have been adopted in this conversion. The independent operating system approach has been dropped in favor of DEC's Disk Operating System. This allows a broader range of disk peripherals to be accessed at a reasonable system development cost. The data file I/O has been centralized to reduce future software development costs and to increase reliability. In fact, several areas of the software have been modularized to reduce redundancy and to improve the maintainability of the overall software system. The converted software package has also been improved from the viewpoint of man-machine interaction. Experience gained through use of the previous system has revealed certain areas where changes are desirable. One such improvement that was made was the adoption of a centralized error reporting scheme. This scheme allowed a more direct control over the errors that were reported by each routine. As a result, the errors are limited to a small set that explains the error conditions more clearly to the user. This and other improvements in the individual option capabilities have resulted in a more powerful and more easily used system. Author (GRA)

N77-27785# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
COMPUTER PROGRAMS FOR MAXIMUM ENTROPY SPECTRAL ANALYSIS OF REAL AND COMPLEX SINGLE-CHANNEL TIME SERIES (WITH MICROFILM PLOTS)
Otto Neal Strand, Jessie M. Young, and Russell B. Chadwick Feb. 1977 43 p refs
(PB-265274/1; NOAA-TM-ERL-WPL-19; NOAA-77030802) Avail: NTIS HC A03/MF A01 CSCL 09B

Various FORTRAN computer programs are described for maximum entropy spectral analysis of a single real or complex time series. The descriptions are in sufficient detail to permit the methods to be correctly implemented. All programs have

been carefully checked out, and are available from the authors on request. GRA

N77-27786# National Cancer Inst., Bethesda, Md.
MAG8E: A PDP10 FILE BASED MAGTAPE UTILITY Final Report
Bruce Shapiro and Peter Lemkin 3 Jan. 1977 15 p refs
(PB-264885/5; NCI/IP-77-01; NCI/IP-TR-12) Avail: NTIS HC A02/MF A01 CSCL 09B

MAG8E is a PDP10 utility program written in SAIL which permits the manipulation and transfer of files between PDP10 magtapes and disks. The tapes that are written are compatible with the PDP8E via an analogous tape utility package called MAG10 that runs on the PDP8E. Thus, file transfers between the two machines are possible. The tape format is 9 track 800 bpi odd parity. GRA

N77-27787# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Sciences.
IMPLEMENTATION OF AN ARRAY BOUND
Norihisa Suzuki and Kiyosh Ishihata (Tokyo Univ., Japan) Nov. 1976 39 p refs
(Contract F44620-73-C-0074)
(AD-A038191; AFOSR-77-0239TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

A practical system to check the correctness of array accesses automatically before actually running programs, has been implemented. The system does not require any modification to input programs in the form of assertions or user interaction to guide proofs. That is, the system generates assertions to prove, synthesizes loop invariants, and finally proves verification conditions without interaction. A powerful proof strategy is invented which makes the time to check programs almost linear to the size of programs, yet the system can completely verify the correctness of array accesses of programs like tree sort and binary search with processing speed of about fifty lines per ten seconds. A three hundred line program example is also shown. Author (GRA)

N77-27788# Air Force Avionics Lab., Wright-Patterson AFB, Ohio.
EFFICIENCY COMPARISON OF JOVIAL-73/I AND AN/AYK-15 ASSEMBLY LANGUAGE Final Report, Aug. - Sep. 1976
W. Lynn Trainor, Mike Burlakoff, and John Garrett Jan. 1977 92 p refs
(AD-A038053; AFAL-TR-76-253) Avail: NTIS MF A01 CSCL 09/2

This report documents and discusses the results of a project undertaken to assess the object code efficiency of the Digital Avionics Information System (DAIS) JOVIAL-73/I compiler relative to manual coding in assembly language. The DAIS JOVIAL-73/I compiler was designed to produce highly efficient object code in terms of both memory size requirements and program execution time requirements. Two sample algorithms were coded in both JOVIAL-73/I and assembly language for the AN/AYK-15 airborne computer. The compiler-produced object code was, in turn, compared to the manually produced assembly language versions. Author (GRA)

N77-27789# Synectics Corp., Rome, N. Y.
FLIP RASTER PROCESSING SOFTWARE SYSTEM Final Technical Report, Sep. 1975 - Jun. 1976
Aldo DiPasqua and Allen V. Lazzara Griffiss AFB, N. Y. RADC Mar. 1977 113 p
(Contract F30602-76-C-0059)
(AD-A038652; RADC-TR-76-383; Rept-723-C-2) Avail: NTIS HC A06/MF A01 CSCL 09/2

This report documents work performed for the Defense Mapping Agency Aerospace Center/Aeronautical Department. The effort consisted of configuring a stand-alone system for the production of Flight Information Publication (FLIP) graphics. The digitizing/editing system was a standard Bendix system 101. A special interface was designed and fabricated to allow the Bendix 101 control (Data General, Nova 1220) to also control a DACOM Model K-661A raster plotter. The software written performed the task of converting linearly digitized files to raster for plotting on the DACOM. This software has the capability to create line-weights from line center files, perform area fills, generate screen fills, and produce alphanumerics in the correct stlye and size. Author (GRA)

N77-27790# Stanford Research Inst., Menlo Park, Calif. Computer Science Lab.
THE DESIGN AND USE OF SPECIFICATION LANGUAGES
Olivier Roubine 3 Oct. 1976 21 p refs
(Contract N00123-76-C-0195)
(AD-A038783; CSL-48) Avail: NTIS HC A02/MF A01 CSCL 09/2

The goal of proving the correctness of computer programs has been hindered by the difficulty of stating formally what is to be proven. The tools developed to achieve this latter purpose often receive the name of specification languages, but the formalization and implementation of such languages has seldom been carried out, and very few of these languages have been described in the literature. We present some design issues concerning specification languages, e.g., desirable properties of such languages, and their limitations, as well as some ideas on their use (and hence on the use of specifications in general) as an integral part of the design process leading to reliable software systems. The (possibly automated) verification of some properties of formal specifications is considered, and some conclusions are drawn concerning the help such an approach can bring in providing greater confidence in the final software product. Author (GRA)

N77-27791# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
SYMBOLIC EVALUATION USING CONCEPTUAL REPRESENTATIONS FOR PROGRAMS WITH SIDE-EFFECTS
Akinori Yonezawa and Carl Hewitt Dec. 1976 45 p refs
(Contract N00014-75-C-0522)
(AD-A038244; AI-M-399) Avail: NTIS HC A03/MF A01 CSCL 09/2

Symbolic evaluation is a process which abstractly evaluates a program on abstract data. A formalism based on conceptual representations is proposed as a specification language for programs with side-effects. Relations between algebraic specifications and specifications based on conceptual representations are discussed and limitations of the current algebraic specification techniques are pointed out. Symbolic evaluation is carried out with explicit use of a notion of situations. Uses of situational tags in assertions make it possible to state relations about properties of objects in different situations. The proposed formalism can deal with problems of side-effects which have been beyond the scope of Floyd-Hoare proof rules and give a solution to McCarthy's frame problem. Author (GRA)

N77-27792# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE COMPETENCE/PERFORMANCE DICHOTOMY IN PROGRAMMING
Vaughan R. Pratt Jan. 1977 20 p refs
(Contract N00014-75-C-0643)
(AD-A038245; AI-M-400) Avail: NTIS HC A02/MF A01 CSCL 09/2

The problem of automating some of the duties of programmers is considered. Our point of departure is the claim that data management has been automated to the point where the programmer concerned only about the correctness (as opposed to the efficiency) of his program need not involve himself in any aspect of the storage allocation problem. The problem of automating aspects of control is considered. To accomplish this a definition of control based on a fact/heuristic dichotomy is proposed. This allows one to operate arbitrarily on the control component of a program without affecting the program's correctness, which is entirely the responsibility of the fact component. The immediate objectives of this research are to learn how to program keeping fact and control separate, and to identify those aspects of control amenable to automation. GRA

N77-27793# Stanford Research Inst., Menlo Park, Calif. Computer Science Lab.
SPECIAL REFERENCE MANUAL
Lawrence Robinson and Olivier Roubine Jan. 1977 63 p refs
(Contract N00123-76-C-0195)

(AD-A038254; CSL-45) Avail: NTIS HC A04/MF A01 CSCL 09/2

This document describes the specification language SPECIAL, which is a tool developed for the design of large software systems. The language is based on a methodology using the concept of a hierarchy of modules, and provides a convenient facility for the description of the properties of such modules. The syntax of the language is described, as well as the semantic notions related to its various constructs. Author (GRA)

62 COMPUTER SYSTEMS

Includes computer networks.

N77-27794*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A COMMUNICATIONS SYSTEM FOR THE TERMINAL AREA EFFECTIVENESS PROGRAM

John L. Fetter Jun. 1977 23 p refs

(NASA-TM-73227; A-6980) Avail: NTIS HC A02/MF A01 CSCL 09B

The terminal area effectiveness program has the broad scope of evaluating air traffic control (ATC) procedures. One area of interest is pilot acceptance of complex ATC procedures. A means to measure this acceptance is described by studying the impact on pilots of meeting the ATC procedural requirements. The concept-testing system configuration, its operation, and its performance are discussed. Author

N77-27795# Los Alamos Scientific Lab., N. Mex.

SYMBIONT SYSTEM FOR INTERCOMPUTER COMMUNICATION USING SHARED MEMORY

R. V. Poore, J. W. Sunier, and D. E. McMillan 1976 15 p Presented at the 2d Annual MUSE Meeting, Ft. Lauderdale, Fla.

(Contract W-7405-eng-36)

(LA-UR-76-2375; Conf-761203-1) Avail: NTIS HC A02/MF A01

Group P-9 at the Los Alamos Scientific Laboratory has three MODCOMP 4/25 computers. The configuration consists of a host computer and two satellite computers. It was decided to implement an intercommunication system using the shared memory feature of the system and symbionts. With this symbiont approach all MAX 4 file I/O operations using REX services are supported. The operation of this system is described in some detail. Among the topics covered are system initialization, common block structure, resources of the tasks, error conditions, limitations, and speed. ERA

N77-27796# RAND Corp., Santa Monica, Calif.

A MANAGEMENT APPROACH TO THE DEVELOPMENT OF COMPUTER-BASED SYSTEMS

R. Turn, M. R. Davis, and R. N. Reinstept Jul. 1976 9 p refs (AD-A037895; P-5686) Avail: NTIS HC A02/MF A01 CSCL 09/2

Many organizations have experienced serious difficulties in developing complex computer-based systems, especially their software components. The problems include large cost overruns, schedule slippages, inadequate performance, and inability to use the system as originally envisioned. One major reason for such lack of success has been the inability of the management of the organization or the development effort to understand the need for a total-system management approach. In particular, acquisition of software and hardware separately with the hope of integrating them later does not work in complex systems. This paper outlines a management approach to acquiring computer systems which encompass the whole system, with emphasis on the software, from the initial concept formulation to the support of the operational system. Expected improvements in the development process and organizational implications of this management approach are discussed. Author (GRA)

N77-27797# Computer Sciences Corp., Falls Church, Va.

DESIGN PLAN FOR GCOS/ARPANET INTERFACE Final Technical Report, 12 Mar. - 12 Dec. 1976

Mar. 1977 180 p

(Contract F30602-76-C-0199)

(AD-A038433; RADC-TR-77-87) Avail: NTIS HC A09/MF A01 CSCL 09/2

This report contains a specification of the hardware/software interface between the Honeywell H635/6180 GCOS System and a PDP 11/35 ELF System for the purpose of providing ARPANET/NSW access. Author (GRA)

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N77-27798*# Kanner (Leo) Associates, Redwood City, Calif.

ERGATIC DYNAMIC CONTROL SYSTEMS

V. V. Pavlov, ed., T. I. Drozdova, ed., Yu. G. Antomonov, ed., V. N. Golego, ed., A. G. Ivakhnenko, ed., and A. M. Meleshev, ed. Washington NASA Jun. 1977 194 p refs Transl. into ENGLISH of the book "Ergaticheskiye Dinamicheskiye Sistemy Upravleniya" Kiev, Naukova Dumka Press, 1975 p 1-160 Original language document was announced as A76-12476

(Contract NASw-2790)

(NASA-TM-75018) Avail: NTIS HC A09/MF A01 CSCL 05H

Synthesis and analysis of systems containing a man in their control circuits are considered. The concepts of ergonomics and ergatic systems are defined, and tasks and problems of ergonomics are outlined. The synthesis of the structure of an astronautic ergatic organism is presented, as well as the synthesis of nonstationary ergatic systems. Problems of selecting the criteria for complex systems are considered, and the results are presented from a study of ergatic control systems with any degree of human participation. Author

N77-27799# Naval Ship Research and Development Center, Bethesda, Md. Computation Mathematics/Logistics Dept.

CONTOUR II: A REVISED SURFACE FITTING AND MAPPING PROGRAM

Mary Beth Marquardt Oct. 1976 49 p refs

(SR0140301)

(AD-A037427; CMD-76-26) Avail: NTIS HC A03/MF A01 CSCL 08/2

This report describes the capabilities and operation of CONTOUR II, a revision of the surface fitting and mapping program originally developed by Mr. A. Beharell, now at the University of Calgary. The program is designed to fit a geometric surface in three-dimensional space to any given set of coordinate data points. The computed smooth surface is then displayed by drawing specified contours on the Calcomp 936 drum plotter. Although this manual includes material contained in the University of Calgary report on CONTOUR, emphasis has been placed on the input changes and additions made to facilitate the use of this program on the CDC 6000 computer systems for engineering calculations of fluid dynamics problems. Details are presented of the control cards and input data preparation for operation of the program. A sample problem is included. Author (GRA)

N77-27800# University of Southern Calif., Los Angeles. Image Processing Inst.

THE DEGREES OF FREEDOM OF SAMPLED IMAGES

Dennis Grant McCaughey Jun. 1977 173 p refs

(Contract F33615-76-C-1203; ARPA Order 3119)

(AD-A037726; USCIPI-730) Avail: NTIS HC A08/MF A01 CSCL 09/4

This dissertation presents a degree of freedom or information content analysis of images and imaging systems in the context of digital image processing. As such it represents an attempt to quantify the number of truly independent samples one gathers with imaging devices. In quantifying the degrees of freedom of an imaging system it is necessary to develop an appropriate model. In this work the imaging system is modeled as a linear system through the continuous-discrete imaging equation. The associated gram matrix is then employed as an aid in defining the system degrees of freedom. The gram matrix eigenvalues are shown to be related to those of the associated continuous-continuous model and can be used to predict the discretized system performance. These ideas are then applied to the

tomorgraphic or projection imaging system; and result in the ability to predict the performance of this system by indicating where redundant data is achieved, and the best ways of increasing the degrees of freedom with a minimum sample increase. The degrees of freedom of sampled image itself are developed as an approximation problem. Here bicubic splines with variable knots are employed in an attempt to answer the question as to what extent images are finitely representable in the context of a digital computer. Relatively simple algorithms for good knot placement are given, and result in spline approximations that achieve significant parameter reductions at acceptable error levels. The knots themselves are shown to be useful as an indicator of image activity, and have potential as an image segmentation device. Author (GRA)

N77-27801# University of Southern Calif., Los Angeles. Image Processing Inst.

THE USC-IMAGE PROCESSING INSTITUTE DATA BASE

Ray Schmidt Oct. 1976 34 p

(Contract F33615-76-C-1203; ARPA Order 3119)

(AD-A037725; USCIPI-710) Avail: NTIS HC A03/MF A01 CSCL 09/4

This report represents effort expended in attempting to meet the needs of the ARPA-IPTO Image Understanding community in providing the availability of a digital image data base. The data base will never be complete as it is the intention of the USC-Image Processing Institute to update and maintain the base as long as the sponsor and scientific community indicates a need for same. The picture files are individually or collectively accessible either over the ARPANET or via the U.S. mails. Author (GRA)

N77-27802# Northwestern Univ., Evanston, Ill. Dept. of Mechanical Engineering.

MINMAX CONTROL SYSTEMS WITH UNCERTAINTY IN THE INITIAL STATE AND IN THE STATE EQUATIONS Interim Report

W. E. Schmitendorf Dec. 1976 8 p refs

(Grant AF-AFOSR-2923-76; AF PROJ. 2304)

(AD-A037763; AFOSR-77-0172TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

This paper investigates optimal control problems where there is uncertainty in the initial state measurement or where there are uncertain parameters in the state equations. It is assumed that nature will choose the uncertainty to maximize the cost which the controller is attempting to minimize. Thus a minmax control is sought. Sufficient conditions for a control to be a minmax control are presented. These conditions suggest methods for finding the minmax control and such techniques are described. The application of these methods is illustrated by example problems. GRA

N77-27803# Southern Methodist Univ., Dallas, Tex. Dept. of Industrial Engineering and Operations Research.

APPROXIMATION TECHNIQUES IN THE SOLUTION OF QUEUEING PROBLEMS

U. Narayan Bhat, Martin J. Fischer (Defense Communications Engineering Center, Reston, Va.), and Mohamed Shalaby Oct. 1976 32 p refs

(Contract N00014-75-C-0597; NR Proj. 042-324)

(AD-A037462; IEOR-76017) Avail: NTIS HC A03/MF A01 CSCL 12/2

In the study of complex queueing systems analysis techniques aimed at providing exact solutions become ineffective. Approximation techniques provide an attractive alternative in such cases. This paper gives an overview of different types of approximation techniques available in the literature and points out their relative merits. Also the need for proper validation procedures of approximation techniques is emphasized. Author (GRA)

N77-27804# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.

ADVANCED LOGIC TECHNOLOGY Final Technical Report, 15 Mar. 1975 - 14 Aug. 1976

G. A. Anderson, E. D. Jensen, R. Y. Kain, K. W. Krause, and J. A. White Feb. 1977 361 p

(Contract F30602-75-C-0148)

(AD-A037834; F0375-FR; RADC-TR-76-388) Avail: NTIS HC A16/MF A01 CSCL 09/2

This report describes an extended-capability content-addressed memory (CAM) which operates on formatted data bases up to around 10 to the 9th power bits in size. The system, called ECAM, consists of a Control Unit and a serial associative store with logic blocks in the 100-gate complexity range provided at each word. The organization is relatively independent of storage technology; the current design assumes charged-coupled device (CCD) memory organized in 4K-bit words, shifted at a 1-microsecond rate. The Control Unit is microprogrammed to interpret a block-structure query language which operates on logical data structures, such as Codd's relations. The mapping of logical structures to operations on physical storage is performed by the hardware. A full repertoire of associative search and arithmetic operators is provided. In its target application, the ECAM will require less than one hour per day to perform a task that was estimated to require between 40 and 700 hours per day on a large commercial mainframe. Author (GRA)

N77-27805# Purdue Univ., Lafayette, Ind. Dept. of Electrical Engineering.

IMAGE UNDERSTANDING AND INFORMATION EXTRACTION Quarterly Report, 1 May - 31 Jul. 1976

T. S. Huang and K. S. Fu Griffis AFB, N. Y. RADC Jan. 1977 147 p refs

(Contract F30602-75-C-0150)

(AD-A036869; RADC-TR-77-17; QR-3) Avail: NTIS HC A07/MF A01 CSCL 09/2

The objective of our research is to achieve a better understanding of image structure and to use this knowledge to develop techniques for image analysis and processing tasks, especially information extraction. Our emphasis is on syntactic decomposition and recognition of imagery based on scene analysis. It is our hope that the results of this research will form the basis for the development of technology relevant to military applications of machine extraction of information from aircraft and satellite imagery. GRA

N77-27806# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

THE DESIGN OF A MECHANICAL ASSEMBLY SYSTEM

Tomas Lozano-Perez Dec. 1976 189 p refs

(Contract N00014-75-C-0643)

(AD-A036734; AI-TR-397) Avail: NTIS HC A09/MF A01 CSCL 09/2

This thesis describes a mechanical assembly system called LAMA. The goal of the work was to create a mechanical assembly system that transforms a high-level description of an automatic assembly operation into a program for execution by a computer-controlled manipulator. This system allows the initial description of the assembly to be in terms of the desired effects on the parts being assembled. Author (GRA)

N77-27807# Brown Univ., Providence, R. I. Div. of Engineering.

CONTROL OF NON-LINEAR SYSTEMS Interim Progress Report, 1 Jan. 1975 - 31 Dec. 1976

Allan E. Pearson 31 Dec. 1976 19 p refs

(Grant AF-AFOSR-2793-75; AF Proj. 2304)

(AD-A037973; AFOSR-77-0285TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

New methods were developed for stabilizing a time-varying linear differential system. Three technical notes involving feedback stabilization of a discrete-time constant linear system, derivation of new lower bounds on the solution matrix to the algebraic matrix Riccati equation, and new sufficient conditions for the linear constant differential-difference system were published. Results have been obtained concerning a minimum energy regulator problem for linear time-invariant systems in which the control variable is subject to an average-power constraint on the response time interval. Author (GRA)

N77-27808# Naval Research Lab., Washington, D. C. Space Sciences Div.

DUAL PERTURBATION CONTROL Interim Report

Warren W. Willman 15 Feb. 1977 49 p refs

(NRL Proj. B01-10; RR0030241)

(AD-A037065; NRL-8) Avail: NTIS HC A03/MF A01 CSCL 12/1

Optimal control laws are investigated for minimizing the expected value of a quadratic criterion with linear dynamics and state measurements, both perturbed by additive white Gaussian noise processes whose intensities depend weakly and linearly on the instantaneous state and control. A dynamic programing approach is used to derive expressions for the optimal control and cost function that are accurate to first order in the noise intensity variations and are given in terms of initial value systems of ordinary differential equations. As compared to the classical 'linear-quadratic-Gaussian' control problem without noise-intensity variations, the first-order optimal control law modifications here are found to be the inclusion of the state covariance matrix as a measurement-driven variable in the state estimator, the appearance of deterministic skewness variables in this estimator, and the addition of a deterministic term to the control. Part of the additive control term can be interpreted as the 'dual control' effect, and it is coupled to the control through a matrix time function whose properties are investigated. A useful refinement of the certainty-equivalence principle is made. When the measurement noise is state-dependent, the differential equations for state estimation have a random driving term containing the scatter matrix of the measurements, which imposes some additional restrictions on the validity of the analysis. Some aspects of the results are shown to generalize to the case of a quadratic exponential criterion, although that situation is more complicated. A method for including the effects of noise intensity gradients in iterative optimization algorithms is described, and a numerical example is given. Author (GRA)

N77-27809# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

VIEWING CONTROL STRUCTURES AS PATTERNS OF PASSING MESSAGES

Carl Hewitt Dec. 1976 62 p refs

(Contracts N00014-75-C-0522; N00014-75-C-0643)

(AD-A038246; AI-M-410) Avail: NTIS HC A04/MF A01 CSCL 09/2

The purpose of this paper is to discuss some organizational aspects of programs using the actor model of computation. This paper presents an approach to modelling intelligence in terms of a society of communicating knowledge-based problem-solving experts. In turn each of the experts can be viewed as a society that can be further decomposed in the same way until the primitive actors of the system are reached. Investigated are the nature of the communication mechanisms needed for effective problem-solving by a society of experts and the conventions of discourse that make this possible. GRA

N77-27810# Southeastern Massachusetts Univ., North Dartmouth. Dept. of Electrical Engineering.

FEATURE EXTRACTION AND SIGNAL PROCESSING APPROACH TO REALTIME PATTERN RECOGNITION Interim Technical Report, 1 Mar. 1976 - 28 Feb. 1977

Chi-Hau Chen Feb. 1977 14 p refs

(Grant AF-AFOSR-2951-76)

(AD-A038920; AFOSR-77-0570TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

This report describes the research progress in the five areas: image processing and display, syntactic character recognition, feature formulation on reconnaissance imagery analysis, seismic pattern recognition, and statistical pattern recognition with finite sample size. Effort on image processing has been concentrated on simple but efficient operations that meet the realtime recognition needs. This includes histogram manipulation, image sharpening, compression, filtering, line detection, etc. Author (GRA)

N77-27811# Minnesota Univ., Minneapolis.

THE STUDY OF DISTRIBUTIVE PARAMETER SYSTEMS FOR FLIGHT CONTROL Final Scientific Report

E. B Lee Mar. 1977 8 p refs

(Grant AF-AFOSR-2243-72)

(AD-A038281; AFOSR-77-0366TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The research conducted was directed toward the development of controller synthesis and analysis techniques for systems with many degrees of freedom. The research results are documented in the published papers, report and Ph.D. theses of the project. Author (GRA)

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N77-27812 Ohio State Univ., Columbus.

ON THE MINIMA OF INDEFINITE BINARY QUADRATIC FORMS Ph.D. Thesis

Mary Flahive Gbur 1976 332 p

Avail: Univ. Microfilms Order No. 77-2402

This shows that if M(f) is attained at least three times, then f(x1,x2) is equivalent to a rational form. Several conditions were developed which together ensure that an element of the Markov spectrum is an accumulation point of both the Lagrange and Markov spectra. Every known limit point of the Lagrange spectrum which is not the Markov value of a rational form (and so, in particular, 1/3) satisfies these criteria. Also, examples are given, showing that the removal of any one of the conditions can result in an element of the Markov spectrum which is not a limit point of both spectra. Classes of elements of the Markov spectrum satisfying these conditions are included. Dissert. Abstr.

N77-27813 State Univ. of New York, Buffalo.

A RATE OF APPROACH TO THE STEADY STATE FOR SOLUTIONS OF 2D ORDER HYPERBOLIC EQUATIONS WITH TIME DEPENDENT VARIABLE COEFFICIENTS Ph.D. Thesis

Wai-Kit Chan 1976 104 p

Avail: Univ. Microfilms Order No. 77-3524

In the first part an algebraic rate of approach to a time harmonic steady state is established for solutions of linear second order hyperbolic equations with time independent variable coefficients. The initial data are assumed to have compact support and a Dirichlet boundary condition is imposed. It is proven that the solution of such an initial-boundary value problem approaches a time harmonic steady state pointwise. In the second part, an algebraic rate of decay is obtained for the local energy of the difference S(x,t)-e to the - iwt power W(x), where S(x,t) is the solution of a second order hyperbolic equation with time and space dependent variable coefficients that satisfies a Dirichlet boundary condition, and has compact initial data. W(x) is a solution of an eliptic equation that satisfies the same boundary condition as S(x,t) and an outgoing radiation condition. The Friedrich's abc-method is applied in both cases to obtain explicit algebraic rates of decay for the local energy of the solutions. Dissert. Abstr.

N77-27814 Rensselaer Polytechnic Inst., Troy, N. Y.

HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS IN A COMPLETE LINEAR NORMED VECTOR SPACE Ph.D. Thesis

John Anthony Goulet 1976 85 p

Avail: Univ. Microfilms Order No. 77-2825

Existence and uniqueness results for the abstract partial differential equation of the form uxy=F(x, y, u, U sub x, U sub y) where values of the unknown function lies in an arbitrary Banach space. The solution is approximated by abstract hyperbolic paraboloids, in a manner analogous to the classical method used in the existence proof for the ordinary differential equation dy/dx-F(x,y) using Cauchy-Euler polygons. Convergence is proven using the abstract versions of the theorems of Ascoli and Arzela; the latter in the case where derivatives of the solutions are involved. Also used is a little known theorem of Mazur in proving pointwise compactness of the aforementioned approximating sequences. Dissert. Abstr.

N77-27815 Dartmouth Coll., Hanover, N.H.

THE FEYNMAN PATH INTEGRAL Ph.D. Thesis

Richard Henry Burkhart 1976 91 p

Avail: Univ. Microfilms Order No. 77-2728

Feynman calculated the path integral as the limit of a sequence of iterated integrals. For the first time it is shown that for a large class of potentials: (1) the iterated integrals exist; (2) they

may be evaluated by a perturbation expansion which is also an asymptotic expansion and has the form of a time-ordered exponential; (3) the limit of the iterated integrals is L squared and L infinity convergent; and (4) the limit factors into the free particle propagator and a potential factor which satisfies a partial differential equation which is closely related to the Schroedinger equation. For the partial differential equation and pointwise convergence theorems it is required that the time dependent potential have six space derivatives which are continuous and uniformly bounded in space and on a time interval. Dissert. Abstr.

N77-27816 Georgia Univ., Athens.
NUMERICAL INTEGRATION RULES WHICH COMBINE INTERPOLATORY AND MINIMUM NORM PROPERTIES Ph.D. Thesis
Patricia Ann Hillhouse 1976 75 p
Avail: Univ. Microfilms Order No. 77-4128

Quadrature rules with preassigned nodes which combine interpolatory and minimum norm properties are considered over a Hilbert space processing a reproducing kernel. Methods of a multivariable calculus and functional analysis are employed to determine the weights of the rules which are called hybrid rules. Hybrid rules are related to an associated optimal rule derived from the hypercircle inequality. Numerical examples consider the space H to the 2nd power (D sub R). Generalized hybrid rules include multiple integrals and illustrate this generalization in H to the 2nd power (D sub R x D sub R). Dissert. Abstr.

N77-27817 Purdue Univ., Lafayette, Ind.
A THIRD-ORDER CURVILINEAR FINITE ELEMENT UTILIZING DISPLACEMENT DERIVATIVE DEGREES OF FREEDOM AND PARTITIONING Ph.D. Thesis
John Andrew Horvath, Jr. 1976 150 p
Avail: Univ. Microfilms Order No. 77-1726

A three-dimensional third-order curvilinear finite element which utilizes partitioning to increase computational efficiency is presented. Cubic displacement functions are formulated to include nodal displacements, their first derivatives and their mixed first derivatives as elemental degrees of freedom, while the initial third-order geometry of the element is described by an array of mapping nodes. Convergence is accelerated by eliminating all mixed derivatives of displacements by partitioning, thereby reducing the size of the element stiffness matrix while retaining complete polynomials in the displacement functions. The partitioned form of the curvilinear element is found to exhibit superior performance over other finite element models having the same total number unrestrained nodal degrees of freedom. Dissert. Abstr.

N77-27818 Texas A&M Univ., College Station.
TRIANGULATIONS WITH SHELLABLE 3-CELLS Ph.D. Thesis
William Owen Murray 1976 65 p
Avail: Univ. Microfilms Order No. 77-2654

The properties of minimal triangulations are shown, and the class of triangulated 3-manifolds which have the free cell property is extended. A new application of shelling 3-cells which involves certain algebraic representations of loops contained in 3-cells is presented. It is shown that a certain class of triangulated, noncompact 3-manifolds, which includes E3, has the free cell property such a triangulation E3 is actually constructed. These results are obtained by using a variation of the techniques of Milnor. It is shown that the operations of forming a certain type of connected sum of two triangulations and of adding a handle in a certain manner to a triangulation, preserve the free cell property. These techniques are applied to show the existence of noncompact 3-manifolds having triangulations with the free cell property. Several examples are included which further demonstrate these methods. Dissert. Abstr.

N77-27819# Georgia Univ., Athens.
COMPLEX VARIABLE TECHNIQUES IN NUMERICAL INTEGRATION AND APPROXIMATION Ph.D. Thesis
Thomas Eugene Price, Jr. 1976 70 p
Avail: Univ. Microfilms Order No. 77-4153

Two fundamental problems in numerical analysis are those of numerical integration and polynomial interpolation. These two basic problems induce a third problem, that of error analysis. This work applies complex analysis methods to these three problems. New interpolation and integration techniques are derived, and an appropriate error analysis is given in each case. Dissert. Abstr.

N77-27820 California Univ., Los Angeles.
EQUATIONAL CLASSES OF NON-ASSOCIATIVE ORDERED ALGEBRAS Ph.D. Thesis
Robert Edward Park 1976 113 p
Avail: Univ. Microfilms Order No. 77-1655

The concept of an upper bound algebra (UBA) as a generalization of semilattices to the pseudo-ordered case. As opposed to WAL's, which have two binary operations, is defined. UBA's have but one binary operation. Tournaments with only one operation are an example of UBA's. It is shown that almost all finite tournaments are functionally complete. Dissert. Abstr.

N77-27821 California Univ., Los Angeles.
MAXIMAL DENSITY SEQUENCES WITH LINEAR CONSTRAINTS Ph.D. Thesis
Michael Allen Morrison 1976 163 p
Avail: Univ. Microfilms Order No. 77-2922

In a general setting the problem treated is that of determining the maximal density which a sequence of non-negative integers can achieve when the terms of the sequence must satisfy an infinite collection of bounded linear functionals. However, it is not this general formulation of the problem which is the central focus, but rather two of its special cases. These concern the maximal density of binary sequences in which either certain spacings between the 1's are not allowed, or certain patterns of 1's are not allowed. Dissert. Abstr.

N77-27822 Northwestern Univ., Evanston, Ill.
SOME RESULTS CONCERNING SOLUTIONS OF THE CAUCHY PROBLEM FOR THE POROUS MEDIUM EQUATION WHEN THE INITIAL DATA HAVE COMPACT SUPPORT Ph.D. Thesis
Barry Franklin Knerr 1976 71 p
Avail: Univ. Microfilms Order No. 77-1282

A second order nonlinear degenerate parabolic partial differential equation known as the porous medium equation is considered, restricting attention to the case of one space variable and to the Cauchy problem where the initial data are nonnegative and have compact support consisting of a bounded interval. Solutions are known to have compact support for each fixed time. It is shown that the interface consists of two monotone Lipschitz curves which satisfy a specified differential equation. Results concerning the behavior of the interface curves as t approaches zero and as t approaches infinity, and that the interface curves are strictly monotone except possibly near t = 0 are proven. Dissert. Abstr.

N77-27823 Rensselaer Polytechnic Inst., Troy, N. Y.
DIRECT ALGORITHMS FOR COMPLEMENTARITY PROBLEMS Ph.D. Thesis
Michael Martin Kostreva 1976 112 p
Avail: Univ. Microfilms Order No. 77-2827

Linear complementarity problems, nonlinear complementarity problems and generalized nonlinear complementarity problems are discussed. The emphasis is on algorithms for solving complementarity problems using a direct approach. In this direct approach a finite sequence of systems of equations are solved approximately. The final system of equations considered represents the complementarity condition at the solution. The algorithms gain efficiency because intermediate systems of equations are reduced dimensionality and high accuracy solutions to intermediate systems are unnecessary. A property of certain nonlinear functions (a subclass of the P-functions) is introduced and denoted by pigeonholing of complementary points. Dissert. Abstr.

N77-27824 Indiana Univ., Bloomington.
A STUDY OF NILPOTENT AND ABELIAN LINEAR GROUPS WITH APPLICATIONS TO FINITE GROUP STRUCTURE Ph.D. Thesis
Bette Louise Warren 1977 60 p
Avail: Univ. Microfilms Order No. 77-2015

Ito has shown that a finite group of linear transformations

of a finite dimensional vector space over a field whose characteristic does not divide the group order is Abelian if all prime divisors of the group order are greater than the dimension of the space. Two generalizations are given for that result for p-solvable groups. Dissert. Abstr.

N77-27825 Iowa Univ., Iowa City.
ON THE APPLICATIONS OF SIMILARITY ANALYSIS Ph.D. Thesis
Hayley Hsi Shen 1976 141 p
Avail: Univ. Microfilms Order No. 77-3773

Four different problems in the physical and natural sciences are studied utilizing the method of similarity analysis (1) ion motion in two-species plasma fluids, (2) behavior of a non neutral one-species plasma fluid, (3) a physiological problem on the function of the liver, and (4) nonlinear transmission lines. The group structure of each problem is found. The forms of boundary conditions which allow similarity solutions are discussed. The reduced ordinary differential equation or set of equations is then solved analytically or treated with numerical or perturbation techniques. It is found that the problem dealing with ion motion in a two-species plasma fluid reduces to a singular numerical problem of nonneutral one-species plasma fluids is solved analytically subject to two physically interesting boundary conditions. Dissert. Abstr.

N77-27826 Colorado Univ., Boulder.
THE STRUCTURAL ANALYSIS AND SOLUTION OF LARGE SYSTEMS OF ALGEBRAIC DESIGN EQUATIONS Ph.D. Thesis
Neil Larry Book 1976 333 p
Avail: Univ. Microfilms Order No. 77-3169

A new and explicit method was developed for expressing the structure of a system of equations called the functionality matrix. The functionality matrix indicates not only the occurence of variables in equations but also the functional form in which they occur. Since the difficulty of solving for a variable is related to its functional form, analysis of the functionality matrix can provide information on the difficulty of solution. Methods for the selection of design variables and redundant equations are demonstrated which provide valuable information leading to an efficient solution for the design problem. A methodology oriented for the solution of design problems by digital computers is described which operates on an unordered set of design equations and a functionality matrix. Algorithms interact with the designer in guiding the selection of design variables and redundant equations. Dissert. Abstr.

N77-27827# Illinois Univ., Urbana. Dept. of Computer Science.
ALGORITHMS FOR SPARSE GAUSSIAN ELIMINATION WITH PARTIAL PIVOTING
A. H. Sherman Jul. 1976 21 p refs
(Contract EY-76-S-02-2382)
(COO-2383-0034) Avail: NTIS HC A02/MF A01

Several algorithms for sparse Gaussian elimination are compared with column interchanges. The algorithms are all derived from the same basic elimination scheme, and they differ mainly in implementation details. Their theoretical behavior is examined and their performances on a number of test problems is compared with that of high quality complete threshold pivoting code. The conclusion is that partial pivoting codes perform quite well and that they should be considered for sparse problems whenever pivoting for numerical stability is required. ERA

N77-27828# California Univ., Livermore. Lawrence Radiation Lab.
SOLUTION OF BLOCK-TRIDIAGONAL SYSTEMS OF LINEAR ALGEBRAIC EQUATIONS
A. C. Hindmarsh Feb. 1977 28 p refs
(Contract W-7405-eng-48)
(UCID-30150) Avail: NTIS HC A03/MF A01

The solution of linear systems with a block-tridiagonal structure is a very common requirement in many applications. This report describes two FORTRAN packages for solving such systems. The first is for the case when all relevant blocks in the coefficient matrix can be stored at once. The second is for the case when they cannot; instead the equations are generated, one block-row at a time, by a user-supplied subroutine. The blocks are assumed to be full, and partial pivoting is done within block-rows only. ERA

N77-27829# Sandia Labs., Albuquerque, N. Mex.
COMPARISON OF SEVERAL RANK TESTS FOR THE TWO-WAY LAYOUT
Ronald L. Iman and William J. Conover (California Univ., Davis) Dec. 1976 53 p refs Presented at Ann. Meeting of Am. Statist. Assoc., Boston, 23 Aug. 1976
(Contract E(29-1)-789)
(SAND-76-0631; Conf-760862-2) Avail: NTIS HC A04/MF A01

There are several rank tests for analyzing certain experimental designs. A comparison is made between the robustness and power of several of these, including the rank transform, aligned ranks, and joint rank sum procedures. The experimental designs studied include the twoway layout with n = 2 and n = 5 observations per cell, the twoway layout with unequal numbers of observations per cell, and the twoway layout with replication. Results are obtained by Monte Carlo simulation of normal, lognormal, and exponential random variables, using linear and nonlinear models. The results show the rank transform procedures to be superior to the other rank tests on the basis of robustness, power, and ease of application. They appear to be preferable to the usual analysis of variance procedures, except where the usual analysis of variance assumptions are met. ERA

N77-27830# Indiana Univ., Bloomington. Dept. of Mathematics.
ASYMPTOTICALLY DISTRIBUTION-FREE ALIGNED RANK ORDER TESTS FOR COMPOSITE HYPOTHESES FOR GENERAL MULTIVARIATE LINEAR MODELS Interim Report
Madan L. Puri (N. C. Univ., Chapel Hill) and Pranab K. Sen 1977 24 p refs
(Grant AF-AFOSR-2927-76)
(AD-A037558; AFOSR-77-0167TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

For general multivariate linear models, a composite hypothesis does not usually induce invariance of the joint distribution under appropriate groups of transformations, so that genuinely distribution-free tests do not usually exist. For this purpose, some aligned rank order statistics are incorporated in the proposal and study of a class of asymptotically distribution-free tests. Tests for the parallelism of several multiple regression surfaces are also considered. Finally the optimal properties of these tests are discussed. Author (GRA)

N77-27831# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A NUMERICAL STUDY OF EIGENVALUE COMPUTATION
Ian T. Young 18 Nov. 1976 32 p refs
(Contract F19628-76-C-0002)
(AD-A036716; ESD-TR-76-322) Avail: NTIS HC A03/MF A01 CSCL 12/1

A study of different numerical methods for computing the eigenvalues of Hermitian matrices has been carried out. The Givens-Householder procedure was found to be the fastest, most accurate method. Relationships among eigenvalue accuracy, word size, form of arithmetic, hardware implementation, and speed are discussed. Author (GRA)

N77-27832# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
BIFURCATION IN THE DUFFING EQUATION WITH INDEPENDENT PARAMETERS Interim Report
Jack K. Hale and Hildebrand M. Rodrigues 1976 24 p refs Sponsored in part by the Sci. Res. Council of Britain
(Contract DAAG29-76-C-0052; Grant AF-AFOSR-2078-71; AF Proj. 2304)
(AD-A036725; AFOSR-77-0112TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

In a previous paper, the authors gave a complete description of the number of even harmonic solutions of Duffing's equation without damping for the parameters varying in a full neighborhood of the origin in the parameter space. In this paper, the analysis is extended to the case of an independent small damping term.

It is also shown that all solutions of the undamped equation are even functions of time. Author (GRA)

N77-27833# Naval Postgraduate School, Monterey, Calif.
THE CALCULATION OF EXP(AT) WITH SOME APPLICATIONS Final Report, 1 Sep. - 31 Dec. 1976
Elmo J. Stewart Feb. 1977 21 p refs
(RR0000101)
(AD-A037428; NPS-53SR77021) Avail: NTIS
HC A02/MF A01 CSCL 12/1

Given A an n x n matrix with real or complex elements, then exp(At) is calculated as the unique solution of an initial value problem. In the process of obtaining this solution n-unknown matrices become involved and must be computed. Characterizing properties of these matrices to be computed become known: such properties as pairwise-orthogonal, idempotent and nilpotent. Finally some applications of the above calculations are given in the field of solutions to systems of differential equations.
Author (GRA)

N77-27834# Naval Postgraduate School, Monterey, Calif.
ERROR BOUNDS FOR THE LANCHESTER EQUATIONS WITH VARIABLE COEFFICIENTS Final Report, 1 Oct. - 31 Dec. 1976
James G. Taylor and Craig Comstock Mar. 1977 15 p refs
(AD-A038012; NPS-53CS77031) Avail: NTIS
HC A02/MF A01 CSCL 12/1

Previous error bounds for the classical Liouville- Green solutions to second order ordinary differential equations are sharpened. Applications are made to the Lanchester model for combat between two homogeneous forces. Author (GRA)

N77-27835# Wisconsin Univ., Madison. Mathematics Research Center.
DESIGNS IN FIVE AND SIX COMPONENTS FOR MIXTURES MODELS WITH INVERSE TERMS
Ralph C. St.John and Norman R. Draper Mar. 1977 45 p refs
(Contracts DAAG29-75-C-0024; NSF-MPS-73-04393)
(AD-A038965; MRC-TSR-1733) Avail: NTIS
HC A03/MF A01 CSCL 12/1

Briefly reviewed are the polynomial plus inverse terms mixture models, and the approximately D-optimal (measure) and D sub n-optimal (exact) designs for these models in three and four components. The use of Atwood's (1973) improvement to Fedorov's D-optimality algorithm is reviewed and further improvements are suggested. In addition, design region and model symmetry, and a simplified procedure for re-distributing design measure, are used to obtain measure designs in five and six components. Finally, exact designs are obtained from these measure designs. GRA

N77-27836# Naval Ship Research and Development Center, Bethesda, Md.
G-PRIME B-SPLINE MANIPULATION PACKAGE BASIC MATHEMATICAL SUBROUTINES Final Report
James M. McKee and Richard J. Kazden Apr. 1977 95 p refs
(AD-A038876; DTNSRDC-77-0036) Avail: NTIS
HC A05/MF A01 CSCL 09/2

This report describes a library of mathematical subroutines for defining and operating on B-spline curves and surfaces. This library contains subroutines for evaluating B-spline functions, for using B-splines as a basis for fitting curves and surface data, and for finding the intersections of B-spline curves and surfaces. An explanation of the general theory, a summary of important properties, and detailed operating instructions for each subroutine are given. A program illustrating a typical use of the basic subroutines has been included along with computer-generated plots of B-spline surfaces and intersection curves. Although the basic evaluation subroutines use previously published techniques, the fitting and intersection procedures represent effective new approaches to the treatment of these old problems.
Author (GRA)

N77-27837# Naval Ship Research and Development Center, Bethesda, Md.
THREE ADDITIONAL ELEMENTS FOR THE FINITE ELEMENT PROGRAM FINEL Final Report
John C. Adamchak Dec. 1970 50 p refs
(AD-A038589; DTNSRDC-3525) Avail: NTIS
HC A03/MF A01 CSCL 12/1

Three additional elements have been added to the element library of the FINEL finite element program: a rectangular membrane element, a rectangular combined membrane and bending element, and a triangular combined membrane and bending element. This report describes the characteristics of the three new elements and includes data on the bending convergence behavior of the combined elements. The stiffness matrices of the three elements are presented in the appendix. Author (GRA)

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N77-27838 Princeton Univ., N. J.
A STATISTICAL ANALYSIS OF COMPUTER SYSTEM BEHAVIOR Ph.D. Thesis
John Charles Turner 1976 176 p
Avail: Univ. Microfilms Order No 77-2169

Several aspects of the behavior of the computer system at Princeton University are investigated. A method for predicting percentiles of turnaround given total backlog and job priority is developed. The predicted percentiles are constant below a backlog of 50 and are then linear in backlog, with the different percentiles having different slopes. A similar model is considered using backlog within priority. The resulting prediction is linear and does not appear to be constant below any level of backlog. To measure the impact of system overhead, the rate at which jobs leave the system is considered as a function of backlog. Maximum likelihood techniques are used to estimate the completion rate as a function of backlog. This leads to a parametric model for completion rate as a function of backlog that increases linearly from zero up to a level between 50 and 75, beyond which it remains constant. Dissert. Abstr.

N77-27839 State Univ. of New York, Buffalo.
CONTRIBUTIONS TO THE THEORY OF SURVIVAL DISTRIBUTIONS Ph.D. Thesis
David William Braun, Jr. 1976 93 p
Avail: Univ. Microfilms Order No. 77-3517

The mixed exponential survivorship function represents the situation where individuals in a population follow (possibly different) exponential survivorship functions. The moments, hazard rate, variance and shape of the mixed exponential survivorship function are considered. These properties help distinguish the mixed exponential survivorship function from the pure exponential survivorship function. The distribution is found of the number of times the empirical distribution crosses the theoretical continuous distribution. A goodness-of-fit test is developed that is based on the pattern of crossings. The test applies in the case of a stochastically different alternative. Scaling the order statistics from an exponential survivorship function by the sample mean is discussed. Moments of all orders are found. A simple test for exponentiality is developed; it is based on the scaled median.
Dissert. Abstr.

N77-27840 North Carolina Univ., Chapel Hill.
THE CONDITIONAL RISK APPROACH TO SELECTION AND RANKING PROBLEMS Ph.D. Thesis
Adolpho Walter P. Canton 1976 211 p
Avail: Univ. Microfilms Order No. 77-2022

The use of the Conditional Risk Procedure is proposed and investigated to construct an index of reliability of decision rules for problems of ranking and selection of populations. The Conditional Risk Procedure is introduced by using a simple problem of a complete ranking of three normal populations with common unit variance. The procedure is then applied to decision rules for ranking and selection problems from Bechhofer's approach and Gupta's approach and a conditional risk index of reliability is obtained for each of the decision rules. The conditional Risk Procedures applied to General Linear Univariate and Multivariate models are studied and applications to special type of designs

are illustrated. Examples are presented to illustrate the procedure. Dissert. Abstr.

N77-27841 State Univ. of New York, Buffalo.
THE AUTOREGRESSIVE METHOD: A METHOD OF APPROXIMATING AND ESTIMATING POSITIVE FUNCTIONS Ph.D. Thesis
Jean-Pierre Carmichael 1976 205 p
Avail: Univ. Microfilms Order No. 77-3519

The Fourier transform of a positive function f(.)(or its sample Fourier transform) is considered as a possibly complex covariance function of a hypothetical stationary complex-valued time series. This time series is modeled by an autoregressive process of order p whose spectral density approximates (or estimates) the function f(.). The equivalence of this interpretation with the theory of orthogonal polynomials on the unit circle is shown. The consistency of the autoregressive estimator as p increases with the sample size is studied. An exploratory investigation is made of this new method as a density estimation method following three approaches: the direct approach, the hazard approach and the sparsity approach. Dissert. Abstr.

N77-27842# Indiana Univ., Bloomington. Dept. of Mathematics.
PROBLEMS OF ASSOCIATION FOR BIVARIATE CIRCULAR DATA AND A NEW TEST OF INDEPENDENCE Interim Report
Madan L. Puri and J. S. Rao 1977 15 p refs
(Grant AF-AFOSR-2927-76)
(AD-A037765; AFOSR-77-0170TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Measures of association and regression suggested thus far in connection with bivariate circular data, have been briefly reviewed. A new test statistic for testing coordinate independence of observations on a torus, is proposed and its asymptotic null distribution derived using Fourier analysis methods.
Author (GRA)

N77-27843# Indiana Univ., Bloomington. Dept. of Mathematics.
CONVERGENCE AND REMAINDER TERMS IN LINEAR RANK STATISTICS Interim Report
Harold Bergstrom and Madan L. Puri Jan. 1977 25 p refs
(Grant AF-AFOSR-2927-76)
(AD-A037766; AFOSR-77-0168TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A new approach to the asymptotic normality of simple linear rank statistics for the regression case is provided along with the estimation of the remainder terms in the approximation to normality. GRA

N77-27844# Indiana Univ., Bloomington. Dept. of Mathematics.
LOCAL MAXIMA OF THE SAMPLE FUNCTIONS OF THE N-PARAMETER BESSEL PROCESS Interim Report
Madan L. Puri and Lanh Tat Tran 1977 15 p refs
(Grant AF-AFOSR-2927-76)
(AD-A036724; AFOSR-77-0111TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

It is proved that almost every sample function of the N-Parameter Bessel process has a local maxima. In addition, some properties related to the local maxima are investigated.
Author (GRA)

N77-27845# Indiana Univ., Bloomington. Dept. of Mathematics.
STOCHASTIC INTEGRALS OF WEIGHTED EMPIRICAL PROCESSES AND AN APPLICATION TO THE LIMITING DISTRIBUTION OF LINEAR RANK STATISTICS UNDER ALTERNATIVES Interim Report. Ph.D. Thesis
Navaratna S. Rajaram Sep. 1976 103 p refs
(Grants AF-AFOSR-2927-76; AF-AFOSR-2009-71)
(AD-A037099; AFOSR-77-0109TR) Avail: NTIS HC A06/MF A01 CSCL 12/1

The phenomenon of Gaussian noise is examined by viewing it as the limiting action of a sequence of disturbances caused by finitely many random variables acting on a certain function space. A central limit theorem for white noise is proved. A connection between-such noise phenomenon and the asymptotic behavior of certain rank statistics is exposed. GRA

N77-27846# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
STOCHASTIC AND ADAPTIVE SYSTEMS Final Report, 1 Feb. 1972 - 31 Jan. 1977
Michael Athans and Sanjoy K. Mitter Mar. 1977 56 p refs
(Grant AF-AFOSR-2273-72; AF Proj. 2304)
(AD-A038640; ESL-FR-731; AFOSR-77-0514TR) Avail: NTIS HC A04/MF A01 CSCL 12/1

Research was carried out on the following main topics: modelling and identification of stochastic systems; structure of non-linear stochastic systems; linear and non-linear filtering; failure detection methods; stochastic control; adaptive control; and control and estimation problems for systems with time delay. Technical details of the research may be found in the reports, theses, and papers cited in the references. A list of publications supported wholly or partially by this grant is included at the end of this report. GRA

N77-27847# Missouri Univ., Columbia. Dept. of Statistics.
MULTI-STAGE TESTS BASED ON SEQUENTIAL RANKS
Richard W. Madsen and John E. Hewett Mar. 1977 22 p refs
(Contract N00014-76-C-0789)
(AD-A038269; TR-62) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper presents a technique for constructing k-stage Wilcoxon rank sum and signed rank tests for testing equality of two distributions. The test statistics suggested for use are functions of the sequential ranks of the observations obtained. When the underlying population from which observations are taken is normal, Monte Carlo studies show that a considerable savings in average sample size can be obtained by using multi-stage tests rather than fixed sample size tests while power levels are maintained. GRA

N77-27848# Missouri Univ., Columbia. Dept. of Statistics.
A K-STAGE TEST PROCEDURE USING P-VALUES
Richard W. Madsen Mar. 1977 24 p refs
(Contract N00014-76-C-0789)
(AD-A038256; TR-61) Avail: NTIS HC A02/MF A01 CSCL 12/1

A k-stage test procedure which combines p-values from independent samples is given. The procedure is non-parametric in the sense that it can be used with any test of hypotheses where p-values can be calculated. Exact test boundaries can be calculated for two-stage tests and approximate boundaries can be found using numerical integration on the computer for three or more stages. Power studies, both exact and Monte Carlo, show that these tests compare favorably with single sample tests while yielding a considerable savings in average sample size. Author (GRA)

N77-27849# Syracuse Univ., N. Y. Dept. of Industrial Engineering and Operations Research.
BAYESIAN SOFTWARE PREDICTION MODELS Interim Report, 8 Dec. 1975 - 8 Dec. 1976
Armit L. Goel Mar. 1977 39 p
(Contract F30602-76-C-0097)
(AD-A039022; TR-76-18; RADC-TR-77-112) Avail: NTIS HC A03/MF A01 CSCL 09/2

Work has been completed on development of Bayesian Software Correction Limit Policies designed to determine the optimum time value that minimizes the long run average cost of debugging at two levels correction action undertaken by the programmer (Phase I) and action undertaken by a system analyst or system designer, if the error is not corrected in Phase I (Phase II). Two models are developed - one assuming the cost of observations of error occurrence and correction time, prior to implementation of the optimum policy, is negligible; the other incorporating the cost of observations. Work was also completed on an Imperfect Software Debugging Model that assumes errors are not corrected with certainty. By assuming the initial number of errors, probability of successfully correcting an error, and constant error occurence rate are all known, formulas for such quantities as distribution of time to completely debugged

software, distribution of time to a specified number of remaining errors, and expected number of errors detected by time t can be derived. Work is currently in progress in extending the Imperfect Debugging Model to incorporate error correction time, estimation of model parameters and development of a Bayesian model; developing bivariate software reliability models where system errors are classified as serious and non-serious; development of empirical models for software error data; development of software reliability demonstration plans for making accept/reject decisions for software packages; and investigating the effects of changes in prior distributions and/or model parameters on quantities of interest. Author (GRA)

N77-27850# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
LINEAR SMOOTHING OF SINGULARLY PERTURBED SYSTEMS
Dean Altshuler Sep. 1976 73 p refs
(Contracts DAAB07-72-C-0259; Grant DAAG29-76-G-0154) (AD-A038268; R-742; UILU-eng-76-2230) Avail: NTIS HC A04/MF A01 CSCL 12/1

A near optimal fixed-interval smoother for singularly perturbed systems is derived using the two filter (forward and backward) formulation. This intuitively-pleasing approach simplifies the fast mode boundary layer complications encountered previously, and results in a much simpler implementation than the exact solution. Application of similar singular perturbation techniques as for the (forward) filters, to the backward filter, results in a near optimal smoother with a similar two time-scale solution for the fast and slow modes. The alternative use of the unrealizable Wiener filter for the fast mode is justified in the interior of the smoothing interval. Finally, a numerical example serves to illustrate how well the near optimal design approximates the exact solution for various values of the perturbation parameter mu. GRA

N77-27851# Air Force Weapons Lab., Kirtland AFB, N.Mex.
DATA ANALYSIS FOR STOCHASTIC PROCESSES Final Report
James E. Negro Feb. 1977 159 p refs
(AD-A038356; AFWL-TR-76-193) Avail: NTIS HC A08/MF A01 CSCL 12/1

This report is tailored for use as a companion document to SIGANAL: A MODULAR SIGNAL ANALYSIS PROGRAM, which is a comprehensive package of software routines for signal analysis applications. The purpose of this report is to yield understanding and interpretation of practical stochastic signal analysis procedures and results. Basic mathematical foundations for stochastic processes are presented and then extended to the calculations of power spectral densities, cross-spectral densities, coherence functions, and transfer functions. Practical aspects of data processing such as sampling, finite materials, and confidence bounds are explained. A simple numerical example is developed to demonstrate most of the analytical tools developed in the report. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N77-27852 California Univ., Los Angeles.
A STUDY OF THE DYNAMICS AND CONTROL OF FLEXIBLE SPATIAL MANIPULATORS Ph.D. Thesis
Josef Maatuk 1976 208 p
Avail: Univ. Microfilms Order No. 77-2919

An analytical tool which contains the essential features for the analysis of spatial flexible manipulators was developed. This tool provides an approach which is sufficiently tractable to be utilized as a design tool, providing engineering insights into the problem. The mathematical model developed for the analysis is based upon a combination of Newton's formulation with the Lagrangian approach. The flexible motion is approximated by a few distributed coordinates. The analytical tool is applied to finding the equations of motion of a particular manipulator. These equations are used to study the dynamic interaction between the dynamics and control of this flexible spatial manipulator. The equations of motion were implemented in a numerical computer program. Results are presented for rigid and flexible cases whose solutions exist in a close forum. A good numerical correlation between the model solution and the closed one was indicated. A general three dimensional maneuver was investigated using the computer program. These results show that presently this tool is an efficient one for the analysis of spatial flexible manipulators. Dissert. Abstr.

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N77-27853 Tennessee Univ., Knoxville.
A SYSTEMATIC STUDY OF CERTAIN CATEGORICAL CONCEPTS IN VARIOUS CATEGORIES OF TOPOLOGICAL SEMIGROUPS Ph.D. Thesis
James Winston Crawley, Jr. 1976 160 p
Avail: Univ. Microfilms Order No. 77-3628

The meaning is examined of a number of categorical notions in various categories of semigroups and topological semigroups. Examples of categories for which certain categorical concepts have the same realization as in the category of sets and functions, as well as categories for which the realizations of the property are more pathological. The primary emphasis is on the categorical concept rather than the particular category. The emphasis is on three specific categories of interest: S (semilattices), Z(compact zero-dimensional semilattices), and cl(compact Lawson semilattices). These categories are studied systematically, with special attention paid to those properties which will be needed in subsequent chapters. Two results of interest are new proofs that epimorphisms are subjective for finite Abelian semigroups and for compact Lawson Semilattices. Dissert. Abstr.

N77-27854 California Univ., Riverside.
LATTICES OF CONGRUENCES ON COMPACT TOPOLOGICAL LATTICES Ph.D. Thesis
Dennis Jay Clinkenbeard 1976 54 p
Avail: Univ. Microfilms Order No. 77-2320

These congruences are exactly those whose homomorphic images phi(L) are Hausdorf when given the quotient topology, or equivalently, whose corresponding homomorphism phi from L onto phi (L) preserves arbitrary meets and joins. Let Theta (L) be the lattice of all closed congruences. It is proven that for any compact topological lattice L, a compact zero dimensional topological lattice can be created from L by simply identifying components in L. Dissert. Abstr.

N77-27855 Florida State Univ., Tallahassee.
INFINITE GALOIS THEORY FOR COMMUTATIVE RINGS Ph.D. Thesis
John Edward Cruthirds 1976 57 p
Avail: Univ. Microfilms Order No. 77-1808

Let S be a commutative ring with identity. If S is assumed to have only finitely many idempotent elements then it is shown that any locally separable subalgebra of S is the fixed subring of a locally finite group of automorphisms of S. Examples are considered which show the scope of these theorems, and the application of these theorems to the finite Galois theory is also studied. A discussion of a groupoid of isomorphisms acting on S is given, and it is shown that such a groupoid arises naturally from G if G is locally finite and compact in the Krull topology on Map (S, S) and R equals to the G power. Dissert. Abstr.

N77-27856 Ohio State Univ., Columbus.
LINEAR DISCRETE TIME SYSTEMS OVER COMMUTATIVE RINGS Ph.D. Thesis
Wai-Sin Ching 1976 88 p
Avail: Univ. Microfilms Order No. 77-2370

In 1942, N. H. McCoy introduced a generalized notion of a rank of a matrix over a commutative ring. It is shown that this generalized rank is the right mathematical object for characterizing many system-theoretic concepts. The first main result is that these criteria generalize to full quotient rings if rank is interpreted as the McCoy rank. The generalized rank criteria makes it possible to investigate the Duality Principle which is established for

systems over Noetherian full quotient rings. Also considered is the problem of pole shifting by feedback, and the dual problem of constructing a state-estimator. Both of these problems are solvable for canonical systems over Noetherian full quotient rings. The problem of the generalization of Ho's algorithm to Noetherian full quotient rings is examined. This approach to studying systems over rings with zero divisors generalizes the usual treatment of systems over domains via their fields of fractions.
Dissert. Abstr.

N77-27857 Dartmouth Coll., Hanover, N.H.
DOUBLE CIRCULANT CODES AND RELATED ALGEBRAIC STRUCTURES Ph.D. Thesis
Emily Hoel Moore 1977 96 p
Avail: Univ. Microfilms Order No. 77-2729

A family of binary codes called double circulant codes are explored. Double circulant codes are defined, and some elementary number theory results are given. The computer programs used are briefly explained; listings of some are included. The automorphism groups of these codes and their related Steiner systems are given. Root systems are briefly introduced, and are used to prove the lattice constructed is the exceptional lattice E sub 8. Sets of simple roots from the lattice are given for root systems of different types. Dissert. Abstr.

N77-27858 State Univ. of New York, Buffalo.
CLOSEST LATTICE POINTS TO A PLANE IN THREE DIMENSIONAL EUCLIDEAN SPACE Ph.D. Thesis
Bertran Keith Marvin 1976 70 p
Avail: Univ. Microfilms Order No. 77-3563

The result that the set of all faces, strictly visible from the origin, of the convex hull of the set of all lattice points which are on one side of a plane passing through the origin but through no other lattice point, and which are in the interior of a sphere with center the origin, consists of a single triangle or a single parallelogram or two triangles are given. The set of all vertices of the visible faces is called an approximation set. The generalization of this result to higher dimensions, and in particular that one of the lemmas does not generalize is discussed. The six possible algebraic relations between successive approximation sets for a fixed plane, fixed lattice and increasing radius are determined. Finally, results which show how to compute the sequence of approximation sets for a fixed plane, fixed lattice and increasing radius, using the same number of operations to compute each new set are given. Dissert. Abstr.

N77-27859 Oklahoma Univ., Norman.
COVERING REFINEMENTS, COLLECTIONWISE NORMALITY AND RELATED PROPERTIES Ph.D. Thesis
Gilbert Michael Reekie, II 1976 62 p
Avail: Univ. Microfilms Order No. 77-1844

Various covering properties of a topological space, particularly C-spaces, are examined. The majority of the theorems include complete normality in the hypothesis. Results obtained are often closely related to Alexandroff's Problem. Also examined is a point set construction of a normal, collectionwise Hausdorff space (a discrete closed set can be separated by a pairwise disjoint open collection), which is not collectionwise normal (a close discrete collection of closed sets exists which cannot be separated by a pairwise disjoint open collection). This construction details a systematic technique in which certain spaces, such as Bing's example G, can be used as a starting point for the construction. Dissert. Abstr.

N77-27860 Bowling Green State Univ., Ohio.
THE LATTICE OF L-GROUP VARIETIES Ph.D. Thesis
Jo Ellen Smith 1976 47 p
Avail: Univ. Microfilms Order No. 77-2702

It is shown that Scrimger varieties can be used to produce varieties minimal with respect to properly containing various other varieties in L. Also discussed are the relations among the Sn'S, and it is established that all infinite collections of Sn'S have the same least upper bound in L. It is proved here that L is not sublattice of the lattice of torsion classes, and conditions are given for when joins in the two lattices will differ. Finally, an inductive construction is given for nested families of l-groups and corresponding varieties, which generalize the Scrimger varieties. These new varieties are examined in some detail.
Dissert. Abstr.

N77-27861# Los Alamos Scientific Lab., N. Mex.
NUMBER THEORY OF THE CONGRUENTIAL RANDOM NUMBER GENERATORS
C. J. Everett Jan. 1977 24 p refs
(Contract W-7405-eng-36)
(LA-6667-MS) Avail: NTIS HC A02/MF A01

The number theory underlying the random number generators gx/sub n/ identically x/sub n + 1/ and gx/sub n/ + c identically x/sub n + 1/mod m is developed in greater detail than is customary with the practical application to random number generation in mind. The arithmetic theory of the mixed generator does not appear in the standard texts, and the treatment here is believed to be new. In any case, it involves many features of interest which are not so well known as the classical theory of primitive roots required for the multiplicative generator. Even the latter theory, as presented below, displays some unorthodox aspects of importance for the construction of generators. An appendix contains a summary of the classical theoretical background. ERA

N77-27862# Naval Research Lab., Washington, D. C.
THE BENEFITS OF CONTEXT IN PROCESSING SETS
Gerald A. Wilson Mar. 1977 20 p refs
(AD-A037822; NRL-MR-3470) Avail: NTIS HC A02/MF A01 CSCL 12/1

The problem of finding unions and intersections of sets in an efficient manner pervades many areas of computer science. A profusion of examples can be found in both business and scientific computer applications. This paper discusses the importance of tailoring the algorithm to be employed to the intended application. A simple union and intersection algorithm is analyzed in detail, and the results of this analysis are compared to several similar analyses published by other researchers. It is shown that some relatively small changes in the nature of the problem conditions and/or the algorithm can lead to significant changes in the expected amount of work required to accomplish the desired task. Author (GRA)

N77-27863# Naval Postgraduate School, Monterey, Calif.
ON THE COMPUTATION OF OPTIMAL APPROXIMATIONS IN SARD CORNER SPACES Final Report, Jul. - Sep. 1976
Richard Franke Dec. 1976 24 p refs
(RR0000110)
(AD-A037691; NPS-53FE76121) Avail: NTIS HC A02/MF A01 CSCL 12/1

This investigation determined that use of the representers of point evaluation functionals can be used as a basis for some problems without encountering severe computational problems. For smooth approximations this is probably not generally true, however. In addition, local approximations must be investigated for smooth interpolation. GRA

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N77-27864*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEST PARTICLE PROPAGATION IN MAGNETOSTATIC TURBULENCE. 3: THE APPROACH TO EQUILIBRIUM
A. J. Klimas, G. Sandri (ARAP, Inc., Princeton, N. J.), J. D. Scudder, and D. R. Howell May 1977 55 p refs
(NASA-TM-X-71338; X-692-77-92) Avail: NTIS HC A04/MF A01 CSCL 20H

The asymptotic behavior, for large time, of the quasi-linear diabatic solutions and their local approximations is considered. A time averaging procedure is introduced which yields the averages of these solutions over time intervals which contain only large time values. A discussion of the quasi-linear diabatic solutions which is limited to those solutions that are bounded from below as functions of time is given. It is shown that as the upper limit of the time averaging interval is allowed to approach

infinity the time averaged quasi-linear diabatic solutions must approach isotropy (mu-independence). The first derivative with respect to mu of these solutions is also considered. This discussion is limited to first derivatives which are bounded functions of time. It is shown that as the upper limit of the time averaging interval is allowed to approach infinity, the time averaged first derivative must approach zero everywhere in mu except at mu = 0 where it must approach a large value which is calculated. The impact of this large derivative on the quasi-linear expansion scheme is discussed. An H-theorem for the first local approximation to the quasi-linear diabatic solutions is constructed. Without time averaging, the H-theorem is used to determine sufficient conditions for the first local approximate solutions to asymptote, with increasing time, to exactly the same final state which the time averaged quasi-linear diabatic solutions must approach as discussed above. Author

N77-27865# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
OPERATING MANUAL FOR 200 kG PULSE MAGNET
K. Hemachalam Sep. 1976 24 p refs
(Contract W-7405-ENG-48)
(LBL-4948) Avail: NTIS HC A02/MF A01

High field magnets have become necessary for measuring properties of superconducting materials. The generation of steady high magnetic field by conventional copper magnets or by superconducting magnets requires great cost for construction as well as operation. Transient fields, however, can be produced less expensively. For this reason, it has been customary to measure high field properties of superconductors in pulsed magnets. The objective of the report given is two-fold: to describe a pulse magnet apparatus in use at this laboratory, and to present an operating procedure to measure current-carrying behavior of superconductors as a function of magnetic field. ERA

N77-27866# California Univ., Berkeley. Lawrence Berkeley Lab.
FAN BEAM AND PARALLEL BEAM PROJECTION AND BACK-PROJECTION OPERATORS
Grant T. Gullberg Jan. 1977 58 p refs
(Contract W-7405-eng-48)
(LBL-5604) Avail: NTIS HC A04/MF A01

Expressions for the fan beam and parallel beam projection and back-projection operators are given along with an evaluation of the point source response for the back-projection operators. The back-projection operator for the fan beam geometry requires the superposition of projection data measured over 360 deg. Both the fan beam and parallel beam geometries have back-projection operators with point source responses which are proportional to 1/mod (r sub 0), and thus two-dimensional Fourier filter techniques can be used to reconstruct transverse sections from fan beam and parallel beam projection data. The two-dimensional Fourier filter techniques may have the speed over other methods for reconstructing fan beam data, but the reconstructed image requires four times the core storage so that the convolution result of one period does not overlap the convolution result of the succeeding period when implementing the fast Fourier transform. ERA

N77-27867# Texas Univ., Austin. Center for Particle Theory.
INDEFINITE METRIC FIELDS AND THE RENORMALIZATION GROUP
T. N. Sherry Nov. 1976 37 p refs
(Contract EY-76-S-05-3992)
(ORO-3992-289) Avail: NTIS HC A03/MF A01

The renormalization group equations are derived for the Green functions of an indefinite metric field theory. In these equations one retains the mass dependence of the coefficient functions, since in the indefinite metric theories the masses cannot be neglected. The behavior of the effective coupling constant in the asymptotic and infrared limits is analyzed. The analysis is illustrated by means of a simple model incorporating indefinite metric fields. The model scales at first order, and at this order also, the effective coupling constant has both ultraviolet and infrared fixed points, the former being the bare coupling constant. ERA

N77-27868# Texas Univ., Austin. Center for Particle Theory.
PREDICTIONS OF VARIATIONS OF THE SPEED OF LIGHT MEASURED BY STABLE CLOCKS
C. B. Chiu, J. P. Hsu, and T. N. Sherry Nov. 1976 14 p refs
(Contract EY-76-S-05-3992)
(ORO-3992-288) Avail: NTIS HC A02/MF A01

Within the framework of the special theory of relativity, it is observed that the speed of light signals measured by two stable clocks is predicted to vary due to the motion of the earth. ERA

N77-27869# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: PHYSICAL SCIENCES AND TECHNOLOGY, NO. 14
14 Jul. 1977 58 p Transl. into ENGLISH from various Russian journals
(JPRS-69419) Avail: NTIS HC A04/MF A01

Data storage techniques, satellite photographs, and industrial management are among topics discussed. J.M.S.

N77-27870# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: PHYSICAL SCIENCES AND TECHNOLOGY, NO. 13
12 Jul. 1977 57 p refs Transl. into ENGLISH from Russian journals
(JPRS-69409) Avail: NTIS HC A04/MF A01

Applications of automated control systems and man's influence on the atmosphere are among the topics discussed. J.M.S.

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution.*

N77-27871*# Kansas Univ. Center for Research, Inc., Lawrence.
A RESEARCH PROGRAM TO REDUCE INTERIOR NOISE IN GENERAL AVIATION AIRPLANES Progress Report, 1 Mar. - 17 Jun. 1977
Ton Peschier, Doug Andrews, and Terry Henderson Jun. 1977 41 p refs
(Grant NsG-1301)
(NASA-CR-153268; KU-FRL-317-2) Avail: NTIS HC A03/MF A01 CSCL 20A

The relevance of KU-FRL test results in predicting (theoretically or semi-empirically) interior noise levels in general aviation aircraft was studied. As a result of this study, it was decided to make a few additions to the program. These additions are: (1) to use three (instead of two) noise sources in the plane wave tube to evaluate the influence of excitation spectrum on panel response, (2) to use theoretical and experimental data obtained in the course of the project to develop more efficient noise reduction materials (or procedures to apply these), or to develop guidelines for the design of such materials for procedures, and (3) to use nonstructural materials in the collection of specimens to be tested in the KU-FRL plane wave tube. Author

N77-27872*# Wyle Labs., Inc., Hampton, Va. Scientific Services and Systems Group.
A FINITE ELEMENT ALGORITHM FOR SOUND PROPAGATION IN AXISYMMETRIC DUCTS CONTAINING COMPRESSIBLE MEAN FLOW
A. L. Abrahamson Jun. 1977 76 p refs
(Contract NAS1-12841)
(NASA-CR-145209; RR-50624) Avail: NTIS HC A05/MF A01 CSCL 20A

An accurate mathematical model for sound propagation in axisymmetric aircraft engine ducts with compressible mean flow is reported. The model is based on the usual perturbation of the basic fluid mechanics equations for small motions. Mean flow parameters are derived in the absence of fluctuating quantities and are then substituted into the equations for the acoustic quantities which were linearized by eliminating higher order terms. Mean swirl is assumed to be zero from the restriction of

axisymmetry. A linear rectangular serendipity element is formulated from these equations using a Galerkin procedure and assembled in a special purpose computer program in which the matrix map for a rectangular mesh was specifically coded. Representations of the fluctuating quantities, mean quantities and coordinate transformations are isoparametric. The global matrix is solved by foreward and back substitution following an L-U decomposition with pivoting restricted internally to the blocks. Results from the model were compared with results from several alternative analyses and yielded satisfactory agreement. Author

N77-27873# Pratt and Whitney Aircraft Group, East Hartford, Conn.

COMBUSTION NOISE INVESTIGATION Final Report

D. C. Mathews, N. F. Rekos, Jr., and R. T. Nagel Feb. 1977 206 p refs

(Contract DOT-FA75WA-3663)

(AD-A038154/1; PWA-5478; FAA-RD-77-3) Avail: NTIS HC A10/MF A01 CSCL 20/1

Improved methods for predicting both direct and indirect combustion noise from aircraft engines were developed and experimentally evaluated by conducting rig experiments and by comparing them with data from several full scale engines. Comparison of predictions with full scale engine data indicate that direct combustion noise is the dominant source for the P&WA engines investigated. The direct combustion noise prediction system includes expressions for acoustic power level, peak frequency and full-scale engine acoustic transmission loss due to combustor/duct coupling and turbine attenuation. These expressions are derived in terms of readily available performance and geometry parameters from the burner and turbine. New parameters introduced by the prediction system include the effects of fuel nozzle number and burner length. Predictions are shown to be in good agreement with data obtained from component rig tests on several JT8D type burner configurations (including single and multiple fuel nozzle, conventional and low emission designs). In addition, when transmission losses are accounted for, the predictions are also shown to be in good agreement with observed combustion noise levels and peak frequencies from four P&WA turbofan engines (i.e. the JT8D-109, JT9D-7A, JT9D-70 and the prototype JT10D). Predicted combustion noise directivity patterns and spectra shapes are determined empirically, using the data from both the rig tests and these four engines.

Author

N77-27874*# Houston Univ., Tex. Dept. of Mechanical Engineering.

ACOUSTICS MEASUREMENTS IN NORMAL JET IMPINGEMENT Final Technical Report, 15 Feb. 1976 - 14 Feb. 1977

S. J. Kleis 14 Feb. 1977 50 p refs

(Grants NsG-1277; NGR-23-004-091)

(NASA-CR-153296) Avail: NTIS HC A03/MF A01 CSCL 20A

The dependence of far field acoustic measurements for a uniform jet on nozzle to plate spacing for small dimensionless spacings (h/d - 0.75 to 3.0) was investigated. Spectra from a real time analyzer were read and processed by an HP 2116 minicomputer in on-line mode. Similar data was generated for a fully developed pipe flow exit condition jet to compare with other investigations. The data base for normal jet impingement was extended to smaller values of nozzle to plate spacing. The effects of slight noise heating (30 deg rise) of the jet on the far field noise produced by the impinging jet are demonstrated.

Author

N77-27875*# Kanner (Leo) Associates, Redwood City, Calif.

AN OVERVIEW OF METHODS IN ELECTRONIC SOUND SIMULATION

Kurt Hillman and Klaus-Peter Gartner Washington NASA Jul. 1977 27 p refs Transl. into ENGLISH of "Uberblick uber methoden zur elektronischen synthese von gerauschen", 1975 Natl. meeting of Deut. Ges. fuer Ortun und Navigation e.V., Bremen, 15-17 Apr. 1975 Original language document was announced as A75-44112

(Contract NASw-2790)

(NASA-TT-F-17433) Avail: NTIS HC A03/MF A01 CSCL 20A

Good sound simulation enhances the realism of vehicle simulators. A survey of methods of electronically synthesizing sounds is presented. A given amount of hardware and computer capacity places an upper limit on the degree and fidelity of sound simulation which is attainable. Good sound realism for aircraft simulators can be especially expensive because of the complexity of flight sounds and their changing patterns through time. Nevertheless, the flight simulator developed at the Research Institute for Human Engineering shows that it is possible to design an inexpensive sound simulator with the required acoustic properties using analog computer elements. The characteristics of the sound components produced by this sound simulator and the control logic for varying its output for takeoff, cruise and approach are discussed.

Author

N77-27876*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A NEW CAPABILITY FOR PREDICTING HELICOPTER ROTOR AND PROPELLER NOISE INCLUDING THE EFFECT OF FORWARD MOTION

F. Farassat (George Washington Univ., Washington, D. C.) and T. J. Brown (Army Air Mobility Research and Development Lab., Cleveland, Ohio) Jun. 1977 25 p refs

(NASA-TM-X-74037) Avail: NTIS HC A02/MF A01 CSCL 20A

The governing equation and computing technique for the prediction of helicopter rotor and propeller noise are described. The method which gives both the acoustic pressure time history and spectrum of the noise includes the thickness and the loading noise. It was adapted to computers resulting in a new capability in noise prediction by removing many of the restrictions and limitations of previous theories. The capability results from the fact that the theory is developed entirely in the time domain. The formulation and the technique used are not limited to compact sources, steady level flight or to the far-field. In addition, the inputs to the computer program are normally available or are amenable to experimental measurements. This program can be used to study rotor and propeller noise with the aim of minimizing the radiated noise to reduce annoyance to the public. Several examples demonstrating the features and capability of the computer program are presented.

Author

N77-27877*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PUBLICATIONS IN ACOUSTICS AND NOISE CONTROL FROM THE NASA LANGLEY RESEARCH CENTER DURING 1940-1976

B. A. Fryer, comp. Jul. 1977 98 p refs

(NASA-TM-X-74042) Avail: NTIS HC A05/MF A01 CSCL 20A

Reference lists are presented of published research papers in various areas of acoustics and noise control for the period 1940-1976. The references are listed chronologically and are grouped under the following general headings: (1) Duct acoustics; (2) propagation and operations; (3) rotating blade noise; (4) jet noise; (5) sonic boom; (6) flow-surface interaction noise; (7) human response; (8) structural response; (9) prediction; and (10) miscellaneous.

Author

N77-27878*# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.

HIGH SPEED HELICOPTER NOISE SOURCES

Albert Lee Jan. 1977 47 p refs

(Grant NsG-2095)

(NASA-CR-151996) Avail: NTIS HC A03/MF A01 CSCL 02A

The state-of-the art of helicopter rotor impulsive noise is reviewed. A triangulation technique for locating impulsive noise sources is developed using once-per-rev index signals as time references. A computer program (INSL) was written implementing this technique. Applying triangulation to the full-scale UH-1 noise data of NASA/Ames Research Center 40- by 80-Foot Wind Tunnel, three different noise sources are found on the rotor disk. The primary sources of thickness noise are in the second quadrant and on the advancing side of rotor disk. Two aerodynamic sources due to blade/vortex interaction are found in the first quadrant.

Author

N77-27879*# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.
A COMPUTER PROGRAM FOR THE IDENTIFICATION OF HELICOPTER IMPULSIVE NOISE SOURCES
Albert Lee Jan. 1977 28 p
(Grant NsG-2095)
(NASA-CR-151997) Avail: NTIS HC A03/MF A01 CSCL 20A

A computer program is presented for calculating the source location of implusive noise in helicopters. The program (INSL) is written in FORTRAN for the CDC 7600 computer. Inputs are the rotor operating conditions and the time intervals (T) between rotor 1/rev index and impulsive noises as measured by different microphones. The outputs are the possible noise source locations in terms of rotor radial and azimuthal coordinates. Typical computer time for a run of six microphone measurements is 1.5 sec, and the cost is about 12 cents for the CDC 7600. Author

N77-27880# United Technologies Research Center, East Hartford, Conn.
AIRFRAME NOISE PREDICTION METHOD Final Report, Jun. 1976 - Apr. 1977
Martin R. Fink Mar. 1977 140 p refs
(Contract DOT-FA76WA-3821)
(AD-A039664; R77-912607-11; FAA-RD-77-29) Avail: NTIS HC A07/MF A01 CSCL 20/1

A noise component method is presented for calculating airframe noise. Noise from clean wing and tail surface is represented as trailing edge noise caused by the turbulent boundary layer. Landing gear noise is given by an empirical representation of model data. Trailing edge flap noise is modeled as a lift dipole normal to the deflected flap, with amplitude and spectrum given by a correlation of flyover data. Measured flyover data for the Prue-2 sailplane, Aero Commander Shirke general aviation airplane, Lockheed JetStar business jet, Boeing 747 commercial jet, and Convair F-106B delta wing airplane are used as test cases. These spectra are compared with predictions by this method and the NASA ANOPP total aircraft method and drag element method. Methods for reducing various components of airframe noise are examined and evaluated. Author

N77-27881*# Aerospace Corp., El Segundo, Calif. Transportation Group Directorate.
TERMINAL AREA AIR TRAFFIC CONTROL SIMULATION Final Report
Jun. 1977 240 p refs
(Contract NAS2-6473)
(NASA-CR-152017) Avail: NTIS HC A11/MF A01 CSCL 20A

To study the impact of advanced aeronautical technologies on operations to and from terminal airports, a computer model of air traffic movements was developed. The advantages of fast-time simulation are discussed, and the arrival scheduling and flight simulation are described. A New York area study, user's guide, and programmer's guide are included. F.O.S.

N77-27882# Naval Research Lab., Washington, D. C. Space Environment Branch.
A SURVEY OF BACKGROUND NOISE FROM ACOUSTIC FREQUENCIES TO OPTIC FREQUENCIES Interim Report
Henry N. Ho Dec. 1976 142 p refs
(AD-A037309; NRL-MR-3429) Avail: NTIS HC A07/MF A01 CSCL 20/14

This report presents a summary of background noise characteristics considered useful for the analysis and specification of performances of receiver systems. The frequency range of interest covers the region from acoustic frequencies to optic frequencies. Extensive data of measured noise characteristics are provided. These measured data show: (1) the acoustic noise in the deep ocean is largely determined by the sea state condition, (2) the radio frequency (RF) background noise between the ELF and HF bands is dominated by radiations from terrestrial lightnings, and (3) from VHF through optic frequencies galactic radiations and atmospheric absorption noises are the major sources of background noise. Author (GRA)

N77-27883*# Texas Univ., Austin. Applied Research Labs.
EXPERIMENTAL STUDY OF OUTDOOR PROPAGATION OF SPHERICALLY SPEADING PERIODIC ACOUSTIC WAVES OF FINITE AMPLITUDE Interim Report
Mark A. Theobald Jan. 1977 171 p refs
(Contracts NAS1-14160; F44620-76-C-0040; N00014-75-C-0867; Grant NOAA-04-5-022-12; AF Proj. 9781)
(NASA-CR-153396; AFOSR-77-0521TR; AD-A039020; ARL-TR-77-5) Avail: NTIS HC A08/MF A01 CSCL 20/1

The outdoor propagation of spherically spreading sound waves of finite amplitude was investigated. The main purpose of the experiments was to determine the extent to which the outdoor environment, mainly random inhomogeneity of the medium, affects finite amplitude propagation. Periodic sources with fundamental frequencies in the range 6 to 8 kHz and source levels SPLm from 140 to 149 dB were used. The sources were an array of 7 to 10 horn drivers and a siren. The propagation path was vertical and parallel to an 85 m tower, whose elevator carried the traveling microphone. The general conclusions drawn from the experimental results were as follows. The inhomogeneities caused significant fluctuations in the instantaneous acoustic signal, but with sufficient time averaging of the measured harmonic levels, the results were comparable to results expected for propagation in a quiet medium. Propagation data for the fundamental of the siren approached within 1 dB of the weak shock saturation levels. Extra attenuation on the order of 8 dB was observed. The measurements generally confirmed the predictions of several theoretical models. The maximum propagation distance was 36 m. The narrowbeam arrays were much weaker sources. Nonlinear propagation distortion was produced, but the maximum value of extra attenuation measured was 1.5 dB. The maximum propagation distance was 76 m. The behavior of the asymetric waveforms received in one experiment qualitatively suggested that beam type diffraction effects were present. The role of diffraction of high intensity sound waves in radiation from a single horn was briefly investigated. Author (GRA)

N77-27884# Johns Hopkins Univ., Baltimore, Md. Dept. of Electrical Engineering.
ROBUST IDENTIFICATION OF LINEAR SYSTEMS Final Report
V. David VandeLinde Aberdeen Proving Ground, Md. BRL Feb. 1977 248 p refs
(Contract DAHC04-72-A-0001; DA Proj. 1T1-61101-A-91A)
(AD-A038294; BRL-1960) Avail: NTIS HC A11/MF A01 CSCL 20/1

The first two sections of this report survey the current techniques of identification and time series analysis for linear, time invariant, single-input, single-output systems with noisy measurements. Typically, this additive noise has been modeled either as being completely specified (e.g., a Gaussian with known parameters) or as being required to satisfy general conditions such as whiteness and non-correlation with the input. Departures from the assumed noise model sometimes cause severe deterioration in the efficiency of available identification algorithms. Since it seems reasonable to have some, if not complete, knowledge of the operating environment, it is assumed in this report that the measurement noise w sub k has a distribution F(W) = (1-e)K(w) - eC(w), where K(,) is a completely specified distribution and C(.) belongs to some broad class of distribution. In the third section, a robust scheme for estimating the system cross correlations is proposed in order to desensitize the performance of the identification algorithm to the distribution of w sub k. Extensive computer simulations show that the proposal provides a robust identification technique which has good uniform behavior over a variety of distribution for w sub k. Author (GRA)

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N77-27885 Texas Univ., Austin.
COLLISION DYNAMICS OF ATOM-MOLECULE SCATTERING VIA THE CROSSED MOLECULAR BEAM TECHNIQUE: Hg+I2, K+CF3I Ph.D. Thesis
Bruce Eric Wilcomb 1976 344 p
Avail: Univ. Microfilms Order No. 77-3999

The reaction of a velocity-selected K beam with a crossed beam of CF3I is studied via the velocity analysis technique. The observed KI product flux (velocity-angle) contour map, obtained at an average relative kinetic energy of 2.9 kcal mol/sec, is transformed to yield the center-of-mass detailed differential reaction cross section. The cross section is backward peaked, but there is a substantial reactive contribution in the forward hemisphere. The average recoil energy of the separating products is 8.5 kcal mol/sec. A nitrogen-seeded supersonic nozzle beam source of metastable mercury is described. Angular distributions of seeded nozzle beams of Hg scattered by a crossed thermal beam of iodine are measured. Crossed molecular beam experiments on the reactive scattering of ground state Hg by iodine are detailed. The qualitative topography of Hg and iodine potential surface is discussed. Dissert. Abstr.

N77-27886 California Inst. of Tech., Pasadena.
STOPPING POWER OF GASES FOR HEAVY IONS Ph.D. Thesis
Nathan Myron Denkin 1977 203 p
Avail: Univ. Microfilms Order No. 77-3129

Pulse height and time of flight methods were used to measure the electronic stopping cross sections for projectiles of C-12, O-16, F-19, Na-23, Mg-29, and Al-27, slowing in helium, neon, argon, krypton, and xenon. The ion energies were between 185 and 2,560 keV. A semiempirical calculation of the electronic stopping cross section for projectiles with atomic numbers between 6 and 13 passing through the inert gases was performed using a modification of the Firsov model. Using Hartree-Slater-Fock orbitals, and summing over the losses for the individual charge states of the projectiles, good agreement was obtained with the experimental data. The main features of the stopping cross section seen in the data, such as the Z sub 1 oscillation and the variation of the velocity dependence on Z sub 1 and Z sub 2, are present in the calculation. Dissert. Abstr.

N77-27887 Kent State Univ., Ohio.
DIFFERENT PERTURBED UNCOUPLED HARTREE-FOCK METHODS FOR PHYSICAL PROPERTIES OF ATOMIC SYSTEMS Ph.D. Thesis
Andreas Davidz 1976 207 p
Avail: Univ. Microfilms Order No. 77-3822

Dalgarno's PUCHF method is defined as PUCHF method C sub 1 and our proposed methods as PUCHF method C sub 1/2 and PUCHF method C sub 0, because they include all of the self-potential, half of the self-potential, and none of the self-potential, respectively. PUCHF methods C sub 0 and C sub 1/2 are similar to PUCHF method C sub 1 in two ways. First, since they are all formulated with an explicitly known zeroth-order many-electron Hamiltonian which corresponds to the unperturbed Hartree-Fock wavefunction, all these PUCHF methods can be improved by using perturbation theory. Secondly, if only first-order corrections are needed, these corrections can be obtained without knowledge of the second-order orbitals. Dissert. Abstr.

N77-27888 Pittsburgh Univ., Pa.
ANALYTIC INVESTIGATIONS OF ATOMIC PHOTOEFFECT Ph.D. Thesis
Sung Dahm Oh 1976 71 p
Avail: Univ. Microfilms Order No. 77-3027

Various aspects of atomic photoeffect were investigated analytically to complement existing numerical studies and to provide basic insight into the process. A single particle description in a central potential is used for the electron wave functions. First the dependence of atomic photoeffect on an initial electron magnetic substate is considered. An application to the angular distribution of the subsequent transition radiation is given. Next photoeffect cross sections are compared with internal conversion coefficients. Finally screened cross sections for K and L shell photoeffect are calculated using screened radial wave functions obtained form an analytical perturbation theory. Closed from expressions are obtained for total cross sections in nonrelativistic dipole approximation. Due to strong cancellations between relativistic and multipole effects, the nonrelativistic dipole results yield accurate predictions for photoeffect for photon energies from threshold to nearly 100 keV. Dissert. Abstr.

N77-27889 Ohio State Univ., Columbus.
LINE INTENSITIES AND HALF WIDTHS OF THE H2O v2 BAND NEAR 2000CM SUP -1 OBTAINED BY USING A LEAST SQUARES FIT METHOD Ph.D. Thesis
Yoon Samuel Chang 1976 126 p
Avail: Univ. Microfilms Order No. 77-2367

A non linear least squares fit program was used to obtain the line intensities and half widths of 91 air-broadened lines in the nu sub 2 rotation-vibration band of water vapor in the region from 1,800 to 2,100/cm. Spectra of water vapor in this region were measured with an Ebert type grating spectrometer. These spectra were taken at room temperature and one atmosphere pressure and the Lorentz expression is used to represent the line shape. The values obtained for the line intensities of H2O lines were compared with the (AFCRL) Atmospheric Absorption Line Parameters Compilation values. The experimental results are, on the average, about 7% stronger than the calculated AFCRL values. Dissert. Abstr.

N77-27890*# IRT Corp., San Diego, Calif.
CROSS SECTIONS FOR CHARGE TRANSFER BETWEEN MERCURY IONS AND OTHER METALS Final Report, Jun. 1973 - Apr. 1977
David A. Vroom and John A. Rutherford 16 Jun. 1977 54 p refs
(Contract NAS3-17759)
(NASA-CR-135205; Rept-8095-046) Avail: NTIS HC A04/MF A01 CSCL 20H

Cross sections for charge transfer between several ions and metals of interest to the NASA electro propulsion program have been measured. Specifically, the ions considered were Hg(+), Xe(+) and Cs(+) and the metals Mo, Fe, Al, Ti, Ta, and C. Measurements were made in the energy regime from 1 to 5,000 eV. In general, the cross sections for charge transfer were found to be less than 10 to the minus 15 power sq cm for most processes over the total energy range. Exceptions are Hg(+) in collision with Ti and Ta. The results obtained for each reaction are given in both graphical and numerical form in the text. For quick reference, the data at several ion velocities are condensed into one table given in the summary. Author

N77-27891*# Kanner (Leo) Associates, Redwood City, Calif.
STUDY ON THE POSSIBILITIES OF ISOTOPIC EXCHANGE BETWEEN C3O2 AND CO LABELED WITH (14)C IN THE PRESENCE AND ABSENCE OF IONIZING RADIATION
A. Faucitano and V. Maxia Washington NASA Jun. 1977 16 p refs Transl. into ENGLISH from La Ric. Sci., Rend. A (Italy), v. 3, no. 2, series 2, 1963 p 131-139
(Contract NASw-2790)
(NASA-TT-F-17435) Avail: NTIS HC A02/MF A01 CSCL 18B

The balances most involved in carbon suboxide isotopic exchanges are induced by carbon monoxide molecules and by carbon atoms deriving from the decomposition of carbon monoxide, and are thus favored by an increase in the carbon monoxide concentration, which is higher in the C3O2 - CO system than in the C3O2 - CO2 system. Water seems to promote isotopic exchanges involving CO2. Author

N77-27892# Oak Ridge National Lab., Tenn.
ELECTRON CAPTURE BY MULTICHARGED IONS
D. H. Crandall 1976 8 p refs Presented at the 4th Ann. Conf. on the Use of Small Accelerators, Denton, Texas, 25 Oct. 1976 Submitted for publication
(Contract W-7405-ENG-26)
(CONF-761059) Avail: NTIS HC A02/MF A01

Research on electron transfer between multicharged ions and neutral targets is reviewed. Data available on systems such as Ar/sup i+/ +Ar and Fe/sup i+/+ H indicate that cross sections as large as 10 to the minus 14th power/sq cm occur for transfer of an electron at collision velocities near and below the velocities of electrons in the atoms. In some cases, quantitatively correct

predications of the cross sections were based on a quasimolecular model of the colliding system. Some of the available data, data needs, and a comparison of experiment and theory for electron transfer at low collision velocities are presented. ERA

N77-27893# Princeton Univ., N. J. Dept. of Chemistry.
INELASTIC MOLECULAR COLLISIONS: APPLICATION OF THEORETICAL METHODS TO PROBLEMS RELEVANT TO LASER OPERATION Progress Report, 1 Feb. - 1 Nov. 1976
Herschel Rabitz 1976 32 p refs
(Contract EY-76-S-02-2542)
(COO-2542-4) Avail: NTIS HC A03/MF A01

Various techniques for describing molecular collision phenomena were developed and implemented to achieve sufficient understanding of these processes such that collision rates of interest (e.g., for gas lasers) may be reliably estimated. The specific molecular systems of H2-H2, HF-He, HF-Ar and HCl-Ar were studied as examples of inelastic molecular collisions. ERA

N77-27894# California Univ., Berkeley. Lawrence Berkeley Lab.
SURFACE CHEMICAL BOND
G. A. Somorjai 26 Aug. 1976 38 p refs Presented at the Congr. on Exploring the Chem. Bond, Amsterdam, 30 Aug. 1976
(Contract W-7405-eng-48)
(LBL-5451; Conf-760870-1) Avail: NTIS HC A03/MF A01

The structure and charge density of solid surface as revealed by low-energy diffraction and electron spectroscopy are discussed. Bonding information for absorbate materials is reviewed.
Author (ERA)

N77-27895# Los Alamos Scientific Lab., N. Mex.
MEASUREMENT OF THE ELASTIC CROSS SECTION FOR POSITIVE PIONS ON CARBON AT 142 MeV Ph.D. Thesis - Wyoming Univ., Laramie
Alden T. Oyer Dec. 1976 112 p refs
(Contracts W-7405-eng-36; E(11-1)-2197)
(LA-6599-T) Avail: NTIS HC A06/MF A01

A measurement of the elastic cross section d sigma/d omega made for the reaction pi i + C-12 yield pi i + C-12 with 142 MeV pions at ten angles ranging from 35 to 85 deg in the laboratory. The spectra from the styrofoam were composed of peaks representing proton elastic, carbon elastic, carbon inelastic and carbon quasi-elastic channels. A function made of Gaussians representing the two body channels and a distribution representing the quasi-elastic channel was fit to the data using a nonlinear least squares algorithm. The ratio of the carbon elastic to proton elastic cross sections was calculated from the areas of the corresponding Gaussians and then multiplied by the proton elastic cross section of Bugg et al eliminating several sources of systematic errors such as beam normalization. ERA

N77-27896# Oak Ridge National Lab., Tenn.
USE OF GROUP THEORY IN THE INTERPRETATION OF INFRARED AND RAMAN SPECTRA
E. Silberman and H. W. Morgan Jan. 1977 43 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5666) Avail: NTIS HC A03/MF A01

Application of the mathematical theory of groups to the symmetry of molecules is a powerful method which permits the prediction, classification and qualitative description of many molecular properties. In the particular case of vibrational molecular spectroscopy, applications of group theory lead to simple methods for the prediction of the number of bands to be found in the infrared and Raman spectra, their shape and polarization, and the qualitative description of the normal modes with which they are associated. The tables necessary for the application of group theory to vibrational spectroscopy and instructions on how to use them for molecular gases, liquids, and solutions are presented. A brief introduction to the concepts, definitions, nomenclature, and formulae is also included. ERA

N77-27897# Yale Univ., New Haven, Conn. Dept. of Chemistry.
ENERGIES AND CONFORMATIONS OF MOLECULES Final Technical Report, 1 Feb. 1972 - 31 Aug. 1976
Kenneth B. Wiberg 31 Aug. 1976 10 p refs
(Contract AF-AFOSR-2239-72)
(AD-A037669; AFOSR-77-0183TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

Energies and conformations of molecules were investigated in several different ways. The effect of angular distortion was studied by ab initio calculations of the energies of variously distorted methanes. The results could be related to the deformation energies found in small ring compounds. The photoelectron spectra of a series of cycloalkenes and methylenecycloalkanes were studied and the ionization potentials compared with the results of ab initio calculations. A remarkably good linear relationship was found, from which information on the reorganization energy and change in correlation energy on going to the ions could be derived. Vibrational intensities in ethylene and related molecules were examined and led to information on the magnitudes of bond dipoles, and to charge distributions. Again, comparison with ab initio calculations provided the key to understanding the intensities. The ultraviolet spectrum of bicyclobutane and of various deuterium substituted derivatives was examined. The high resolution spectrum of the first transition permitted the determination of the equilibrium geometry of this state. An automated calorimetric system was developed. The heats of isomerization of quadricyclane, tricyclooctane and benzvalene were determined. Author (GRA)

N77-27898# Illinois Univ., Urbana-Champaign. Dept. of Chemistry
HIGH-PRESSURE NUCLEAR MAGNETIC RESONANCE RELAXATION STUDY OF SUPERCRITICAL DENSE FLUIDS Final Report, 1 Mar. 1972 - 31 Dec. 1976
Jiri Jonas Mar. 1977 18 p refs
(Grant AF-AFOSR-2286-72)
(AD-A037966; AFOSR-77-0211TR) Avail: NTIS HC A02/MF A01 CSCL 20/8

The dynamic structure of simple polyatomic molecular fluids such as CF4, SF6, CFCl3, C4 F8, FC6D5, has been studied by nuclear magnetic resonance relaxation techniques. The effects of temperature and pressure on the transport and relaxation behavior of fluids in the supercritical dense fluid region have been investigated. These systematic studies led to the main conclusions of some of the general character: (1) Validity of the rough hard sphere model of liquids to describe transport and relaxation behavior of simple dense fluids; (2) Angular relaxation in fluids can be approximated as occurring through a sequence of uncorrelated binary collisions; (3) Importance of many-body correlation effects on self-diffusion which depends on transfer of linear momentum; (4) The results provided experimental verification of the molecular dynamics calculations for hard sphere systems; and (5) Applicability of the rough hard sphere model of liquids to describe relaxation and transport processes in binary mixtures. GRA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N77-27899# Sandia Labs., Albuquerque, N. Mex.
TRANSMISSION AND COMPRESSION OF AN INTENSE RELATIVISTIC ELECTRON BEAM PRODUCED BY A CONVERGING ANNULAR DIODE WITH RETURN CURRENT FEEDBACK THROUGH THE CATHODE. PART 2: THE EXPERIMENTS
J. G. Kelly and R. L. Schuch Feb. 1976 85 p refs
(Contract E(29-1)-789)
(SAND-75-0668) Avail: NTIS HC A05/MF A01

The complete results of the experiments with the converging annular diode within return current feedback through the cathode (Triax) are reported. The diode was designed to focus a relativistic high current electron beam to a small focus. It did achieve a factor of 10 areal compression with 50 percent efficiency. There were two principal reasons for this shortfall. First, the rapid

diode plasma motion of 10 cm/microseconds that was discovered necessitated the use of larger A-K gaps than expected and led to thicker beam sheets than are needed for good focusing. Second, the intrinsic angular spread of the electrons, even from the best cathode surfaces, introduced excessive angular momentum into the beam so that only a minor portion of the electrons could reach the axis. ERA

N77-27900# Sandia Labs., Albuquerque, N. Mex. Directorate of Physical Research.

ELECTRON-BEAM-FUSION Progress Report, Jan. - Jun. 1976

Oct. 1976 121 p refs

(Contract E(29-1)-789)

(SAND-76-0410) Avail: NTIS HC A06/MF A01

Research progress is reported for the following areas: (1) Proto I, (2) Proto II, (3) EBFA, (4) power flow, (5) contract progress reports, (6) progress in the Sandia program, (7) repetitively operated pulse generator development, (8) electron beam power from inductive storage, (9) fusion target design, (10) beam physics research, (11) power flow, (12) heavy ion fusion, (13) particle beam source development, (14) beam target interaction and target response studies, (15) diagnostic development, and (16) hybrid systems. ERA

N77-27901# Battelle Columbus Labs., Ohio.

EXPERIMENTAL SCREENING OF CARBON-BASE MATERIALS FOR IMPACT MEMBERS IN ISOTOPIC HEAT SOURCES

G. K. Bansel and W. H. Duckworth Nov. 1976 37 p refs

(Contract W-7405-eng-92)

(BMI-X-673) Avail: NTIS HC A03/MF A01

Several C/C composites and reentry-grade bulk graphites were evaluated experimentally to determine their applicability for impact member use in radioisotope heat sources. The composites included the following generic types: (1) 2-D cloth lay-ups; (2) 2-D and 3-D felts; (3) 3-D weaves; (4) 3-D pierced fabrics; (5) 7-D weave; and (6) coarse polar weave. A 2-D ramdomly wound, resin-impregnated C/C material (GIS) was also included. The various materials were evaluated as energy absorbing materials. None of the materials performed appreciably better than the GIS impact member material. Pyro Carb 903 and Carbitex 700 were somewhat superior in performance, while the bulk graphites and felt-base composites ranked least effective as energy absorbers. The results as a whole suggest that Pyro Carb 903 is the best prospect for a bifunctional heat shield and impact member. Its high density (1.80g/cm3) indicates potentially good ablation resistance to accompany its indicated good performance as an energy absorber. ERA

N77-27902# Brookhaven National Lab., Upton, N. Y.

EXPERIMENTAL STUDY OF ELECTRON COOLING

G. I. Budker, N. S. Dikanskii, V. I. Kudelainen, I. N. Meshkov, V. V. Parkhomchuk, D. V. Pestrikov, A. N. Skrinskii, and B. N. Sukhina 1976 55 p refs Transl. into ENGLISH from Russian paper IYaF-76-33 55 p Sponsored by ERDA

(BNL-TR-635; IYaF-76-33) Avail: NTIS HC A04/MF A01

In electron-positron storage rings the damping of particle oscillations is achieved by synchrotron radiation. Since this effect is practically absent in heavy-particle accelerators, multiple accumulation of particles is achieved by electron cooling. Results are given of experiments done in 1974-1975 on electron cooling of a proton beam. Although some of these results have been published, the more important results are included for completeness. Electron cooling makes possible multiple stacking of heavy particles. Studies have shown that by using this technique it is possible to stack intense antiproton beams that produce a luminosity of greater than or equal to 10 to the 31st power/sq cm/sec of the proton-antiproton colliding beams. ERA

N77-27903# California Univ., Livermore. Lawrence Livermore Lab.

MONTE CARLO EFFICIENCY PREDICTIONS FOR A PORTABLE 3He NEUTRON DETECTOR

Austin A. ODell 20 Oct. 1976 18 p

(Contract W-7405-eng-48)

(UCRL-52151) Avail: NTIS HC A02/MF A01

A small, manportable neutron detector using 183He proportional counters arranged in 3 banks within a polyethylene moderator is described. Each counter is 25 mm in diameter and 340 mm long and is filled with highly purified 3He to a pressure of 400 kPa. Measurements of the detector efficiency were made using a calibrated 252CF neutron source. Then, independent calculations of the detector efficiency were performed with the TART Monte Carlo transport code. Calculations and measurements for several source/detector arrangements and moderator configurations are compared to evaluate the accuracy of the TART code in predicting the efficiency of small 3HE neutron detectors. GRA

N77-27904# California Univ., Livermore. Lawrence Livermore Lab.

EFFECTS OF DENSITY GRADIENT MODIFICATION ON FLUID INSTABILITY IN THERMONUCLEAR MICRO-IMPLOSIONS

J. D. Lindl, R. O. Bangerter, J. H. Nuckolls, W. C. Mead, and J.J. Thomson 24 Sep. 1976 31 p refs Presented at European Conf. on Laser Interaction with Matter, Palaiseau, France, 18 Oct. 1976

(Contract W-7405-eng-48)

(UCRL-78470; Conf-761025-7) Avail: NTIS HC A03/MF A01

The presence of hydrodynamic fluid instability at the ablation surface puts constraints on the kinds of targets, surface finish, and energy sources that one can use for thermonuclear micro-implosions. If Taylor-like modes grow at near the classical value, one is limited to low aspect ratio shells and surface finishes of 10-100 A. These surface finish requirements can be reduced by 1 to 2 orders of magnitude by exploiting density gradient modification techniques to obtain a shallow density gradient at the ablation surface. For laser driven targets, the gradient is achieved by utilizing suprathermal electrons with a high energy 'get lost' region to eliminate severe preheat problems. For charged particle sources, the reduction is achieved by introducing an energy spread on the driving source. ERA

N77-27905# Sandia Labs., Albuquerque, N. Mex. Plasma Theory Div.

DOUBLE-SHELL TARGETS AT LOW ELECTRON-BEAM POWER

M. A. Sweeney 1976 11 p Presented at the Plasma Phys. meeting of the Am. Phys. Soc., San Francisco, 15-19 Nov. 1976

(Contract E(29-1)-789)

(SAND-76-5727; Conf-761108-1) Avail: NTIS HC A02/MF A01

Electron beam requirements for obtaining measurable compressional neutrons on present-day accelerators with doubleshell targets are discussed. In such a target, the inner pusher is separated from the outer ablator-pusher region by a low-density buffer gas. Because of velocity multiplication and spherical convergence, the inner pusher moves at a higher implosion velocity. The buffer gas serves to enhance the elasticity of the collision of the outer inner pushers. The target has the advantage of small fuel mass--as for a small, thick-shell target--but without the requirement of a tighter beam pinch. Unlike the other two targets shown, a double-shell target scales to breakeven. ERA

N77-27906# California Univ., Berkeley. Lawrence Berkeley Lab.

NUCLEAR STRUCTURE AT HIGH ANGULAR MOMENTUM

F. S. Stephens Aug. 1976 126 p refs Presented at the Intern. School of Phys., Varenna, Italy, 26 Jul. 1976

(Contract W-7405-eng-48)

(LBL-5047; Conf-760747-1) Avail: NTIS HC A07/MF A01

The high angular momentum states of nuclei are investigated. Topics discussed include modeling traditional nuclei where two types of rotational bands (decoupled and strongly coupled) occur frequently; the processes causing backbending (irregularities in rotational levels of certain nuclei); the mixing of the ground band with an alignment of individual nucleons; and the very high spin states where effective moments of inertia were obtained for spins up to 50h. ERA

N77-27907# Office of Naval Research, London (England).
POSITRON ANNIHILATION: FROM QED TO NDT A PRIMER AND A REPORT ON THE 4TH INTERNATIONAL CONFERENCE ON POSITRON ANNIHILATION, HELD AT HELSINGOR, DENMARK, 23-26 AUGUST 1976
Abraham Sosin 23 Feb. 1977 51 p refs
(AD-A037907; ONRL-C-38-76) Avail: NTIS HC A04/MF A01 CSCL 20/8

This report summarizes the presentations at the meeting and attempts to emphasize the highlights of the developments in the field of positron annihilation. As a preliminary to the conference review, this report also provides an introductory survey of positron physics and experimental methods for readers largely unfamiliar with positron annihilation. GRA

74 OPTICS

Includes light phenomena.

N77-27908*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SHOCK TUBE MEASUREMENTS OF THE OPTICAL ABSORPTION OF TRIATOMIC CARBON, C3
Jim J. Jones Jun. 1977 40 p refs
(NASA-TM-X-74025) Avail: NTIS HC A03/MF A01 CSCL 20F

The spectral absorption of C3 has been measured in a shock tube using a test gas mixture of acetylene diluted with argon. The absorption of a pulsed xenon light source was measured by means of eight photomultiplier channels to a spectrograph and an accompanying drum camera. The postshock test gas temperature and pressure were varied over the range 3300-4300 K and 0.36 to 2.13 atmospheres, respectively. The results showed appreciable absorption from C3 for the wavelength range 300 to 540 nanometers. The computed electronic oscillator strength varied from 0.12 to 0.06 as a function of temperature. Author

N77-27909*# Scientific Translation Service, Santa Barbara, Calif.
VARIABILITY OF THE SPECTRAL-BRIGHTNESS INDICATORS OF NATURAL OBJECTS UNDER VARIOUS CONDITIONS OF REMOTE MEASUREMENT (TO THE QUESTION OF STANDARDIZING SPECTRAL-BRIGHTNESS INDICATORS OF NATURAL OBJECTS)
V. I. Tarnopol'skiy Washington NASA Jun. 1977 33 p refs Transl. into ENGLISH of the report "Izmenchivost Spectral'noYarkostnykh Priznakov Prirodnykh Ob'yektov v Razlichnykh Uscoviyakh Distantsionnogo Izmereniya (k Voprosy o Normirovannii Spektral'noyarkostnykh Priznakov Prirodnykh Ob'yektov)", Moscow, Acad. of Sci., 1976 p 1-20
(Contract NASw-2791)
(NASA-TT-F-17542) Avail: NTIS HC A03/MF A01 CSCL 20F

The variability of spectral brightness measurements, which form the basis of the multispectral method was examined. Emphasis was placed on surveying the information on the angular structure of the reflected and thermal radiation fields and their diurnal variations associated with the position of the sun. Questions of normalizing the spectral brightness characteristics and the principle involved in constructing the corresponding algorithms and models are considered. Author

N77-27910*# Kanner (Leo) Associates, Redwood City, Calif.
THEORY OF CONIC LIGHT GUIDE SYSTEM OF MATCHING AN IR RECEIVER WITH TELESCOPE OPTICS AND MACHINE SIMULATION OF ITS CHARACTERISTICS
M. Z. Khokhlov Washington NASA Jun. 1977 68 p refs Transl. into ENGLISH of "Teoriya Konicheskogo Svetovoda Sistemy Soglasovaniya IK-Priyemnika s Optikoy Teleskopa i Mashinnoye Modelirovaniye Yeye Kharakteristik", Pr-304 Inst. of Space Research, Acad. Sci. USSR, Moscow, 1976 p 1-32
(Contract NASw-2790)
(NASA-TT-F-17543; Pr-304) Avail: NTIS HC A04/MF A01 CSCL 20F

The characteristics of quasi-optical elements of a system of radiation input to a cryostat and of matching an IR receiver and telescope optics by stopping down the conic light guide, narrowing its outlet angular aperture and using a field lens (mirror) and cyclindrical light guide were examined in an approximation to geometric optics. Analytical expressions were obtained for the conic light guide beam pattern which agree well with results of machine simulation, considering radiation loss in the matching system, the angular distribution of radiation at its outlet, and the effect of the cylindrical light guide and field lens on the beam pattern. Stopping down and the field lens permit narrowing the lobes of the beam pattern almost to an ideal rectangular shape, while narrowing its outlet angular aperture with a second conic light guide permits reduction of the beam width practically without increasing loss. Author

N77-27911# Arizona Univ., Tucson.
IMAGE QUALITY THROUGH THE ATMOSPHERE Ph.D. Thesis
Wayne Warren Metheny Mar. 1977 178 p refs
(Contract F33615-74-C-1088)
Avail: NTIS HC A09/MF A01

The optical image quality is developed in terms of the optical transfer function (OTF), the point spread function (PSF) and the pupil function for a camera with time varying wavefronts due to atmospheric turbulence. The conditions for separating the OTF into an independent atmospheric part (ATF) and an optical system part are extended to cover intermediate time exposures. A measurement technique using a two point source transmitter is developed from fundamental considerations which can be applied to the measurement of the ATF or the atmospheric pupil function. The Specific application of a down looking, airborne camera is chosen for a detailed error analysis of the technique. A ground test over a 3.5 mile and a 600 foot horizontal path is described. Calculations of the ATF for various geometries are considered. Both long exposure time calculations (using a new model of the outer scale) and intermediate exposure time calculations (using computer generated sample wavefronts) are made. Author

N77-27912*# Hughes Aircraft Co., Los Angeles, Calif. Space and Communications Group.
THEMATIC MAPPER CRITICAL ELEMENTS BREADBOARD PROGRAM Final Report, 29 Jun. 1974 - 31 Jan. 1976
C. H. Dale, Jr., J. L. Engel, and E. D. Harney 1 Apr. 1976 501 p
(Contract NAS5-20589)
(NASA-CR-153889; HS-236/D2241; SCG-60165) Avail: NTIS HC A22/MF A01 CSCL 20F

A 40.6 cm bidirectional scan mirror assembly, a scan line corrector and a silicon photodiode array with integral preamplifier input stages were designed, fabricated, and tested to demonstrate performance consistent with requirements of the Hughes thematic mapper system. The measured performance met or exceeded the original design goals in all cases with the qualification that well defined and well understood deficiencies in the design of the photodiode array package will require the prescribed corrections before flight use. Author

N77-27913# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
IR WINDOW STUDIES Interim Report, Sep. 1975 - 31 Mar. 1976
John H. Marburger Aug. 1976 104 p refs
(Contract F19628-76-C-0162; ARPA Order 2055)
(AD-A037009; RADC-TR-76-260; IR-1) Avail: NTIS HC A06/MF A01 CSCL 17/5

This report describes progress on the first six months of effort on a program of infrared window studies. Studies related to thermal lensing include quantitative measurements of thermal lensing in CdTe, measurement of the three independent strain optic coefficients in CdTe and GaAs using an acousto-optic technique, and a theory of thermally induced birefringence in polycrystalline materials. Effort also focussed on defects in IR window materials, including a study of microscopic imperfections in CdTe and ZnSe in which the techniques of electron microscopy, infrared absorption spectroscopy and transport property measurements were brought to bear on samples prepared here for this purpose. The third area of study included measurements of laser damage characteristics of IR window materials at both 10.6 micrometers and in the 2-5 micrometers region. An effort

to use surface acoustic waves to measure surface absorption was successfully completed during this period. A surface absorption as small as 0.0001 could be directly measured in the presence of a large bulk absorption, 0.0001/cm. Analyses of this work suggest that surface absorptions as low as 0.00001 could be measured. This technology is being transferred to the China Lake Naval Weapons Center for refinement and extended use. Author (GRA)

N77-27914# Decilog, Inc., Melville, N. Y.
ANALYSIS OF THE M113 PANORAMIC TELESCOPE RADIOACTIVELY ILLUMINATED RETICLE
J. Richard Goldgraben and C. Thomas Goldsmith Nov. 1976 34 p refs
(Contract DAAA25-77-M-0055)
(AD-A034153; TR-155) Avail: NTIS HC A03/MF A01 CSCL 17/8

Historically, reticles in optical instruments were illuminated by a battery powered incandescent source for use at night. The source luminance was controlled by means of a potentiometer, and was equipped with an On/Off switch. Thus, as evening twilight approached, and the dark lines became difficult to see against the scene, the reticle light was turned on. Initially, high reticle illumination would be used, and, as the scene became increasingly dark, the reticle would be dimmed. When tritium activated sources of illumination became available, it became feasible to eliminate the battery and incandescent source with a concomitant savings in cost and increase in reliability. In the M113 Pantel, for example, the reticle is constantly illuminated by the radioactive source. Therefore, there exists a time at twilight when the reticle cannot be seen as either dark lines or lighted lines. This report defines the problem, presents some short term solutions to the problem, and suggests an experimental program designed to create a reticle design data base and handbook. GRA

N77-27915# Xonics, Inc., Santa Monica, Calif.
THEORETICAL STUDIES OF HIGH-POWER ULTRAVIOLET AND INFRARED MATERIALS Technical Report, 1 Jan. - 30 Jun. 1976
M. Sparks and C. J. Duthler 30 Jun. 1976 232 p refs
(Contract DAHC15-73-C-0127)
(AD-A034088; TR-7) Avail: NTIS HC A11/MF A01 CSCL 20/6

Contents: Polymer Coatings for Protection of Optical Components; Electronic Properties of the LiF Valence Band, Surface States and the Local Density of States Near the Surface; Localized Electronic States in Alkali Halides Associated with a Substitutional Anion Impurity; Classical Transport Equation for Electron-Avalanche Breakdown; Evaluation of Two-Center Integrals of Slater Atomic Orbitals; Quasiselection Rules for Multiphonon Absorption in Alkali Halides; Irradiance limits for Vacuum-Ultraviolet Material Failure; and Materials for High-Power Window and Mirror Coatings and Multilayer-Dielectric Reflectors. GRA

N77-27916# Purdue Univ., Lafayette, Ind.
PHOTOGRAMMETRIC ASPECTS OF THE HETERODYNE OPTICAL CORRELATOR Contract Report
Edward M. Mikhail Jul. 1976 51 p refs
(Contract DAAGZ9-76-D-0100)
(AD-A038497; ETL-0095) Avail: NTIS HC A04/MF A01 CSCL 08/2

Heterodyne optical correlation as applied to coherently illuminated overlapping transparencies is briefly discussed. Photogrammetric aspects of optical image coincidence are carefully studied for vertical as well as tilted photography. An experimental Heterodyne Optical Correlator (HOC) is described. A two-dimensional photo diode detector array is used in the output plane as a precise measuring system. It is shown that for regular aerial photography, it is not possible to place the transparencies untilted in the correlator and expect tolerable y-parallaxes. Therefore, either the transparencies must be tilted, or the HOC should operate essentially as a comparator, with correlation taking place in the image space. For the latter case, one transparency is fixed and the other is moved in steps in both the x and y directions. The result is that for each array element one gets x, y coordinates on one transparency and px, py parallaxes from the other. The results of two preliminary tests using aerial photography are given. However, the tests are so limited that the results should be considered only as preliminary, indicating the feasibility of the system as an area correlator. Further development and more extensive testing are recommended before the potential and accuracy of the HOC system may be determined. Author (GRA)

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N77-27917 Texas Univ., Austin.
A CHEMICAL-PHYSICAL MODEL OF PLASMA FORMATION IN THE TEXAS TURBULENT TORUS Ph.D. Thesis
David Joel Kaplan 1976 185 p
Avail: Univ. Microfilms Order No. 77-3928

Maxwellian rate coefficients for each reaction were calculated using the best cross sectional data available. Wall effects are included in the model. It is assumed that neutrals are lost to the wall in the atomic form and are released from the walls in the molecular form. A set of differential equations was set up with the initial condition that the only species present are molecular hydrogen or deuterium plus a small variable percentage of electrons and charge-balancing ions. The model assumes spatial homogeneity of all species. It was found possible to choose plausible values of the various parameters which resulted in rough quantitative agreement with the time dependent behavior of all observed species. Dissert. Abstr.

N77-27918 North Carolina State Univ., Raleigh.
BEAM-PLASMA INSTABILITIES AND NONLINEAR ELECTRON WAVES IN A HELICAL-BEAM, MAGNETIC MIRROR PLASMA Ph.D. Thesis
Edward Perry Scannell 1976 250 p
Avail: Univ. Microfilms Order No. 77-2754

The possibility of using the plasma produced by a helical electron beam in a magnetic mirror geometry to study large amplitude electron plasma waves was investigated in the Allis mode. Results indicate that the helical-beam system is not suitable for nonlinear electron wave studies. Suggestions are made for certain modification on the apparatus so that it could be used to better investigate the beam-plasma instabilities. With electrical isolation from the region of study it could still be used as a source of quiescent plasma for wave experiments. Dissert. Abstr.

N77-27919*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTIMIZATION OF CONFINEMENT IN A TOROIDAL PLASMA SUBJECT TO STRONG RADIAL ELECTRIC FIELDS
J. Reece Roth 1977 33 p refs Presented at Intern. Conf. on Plasma Sci., Troy, N. Y., 23-25 May 1977; sponsored by IEEE
(NASA-TM-X-73690; E-9225) Avail: NTIS HC A03/MF A01 CSCL 20I

A preliminary report on the identification and optimization of independent variables which affect the ion density and confinement time in a bumpy torus plasma is presented. The independent variables include the polarity, position, and number of the midplane electrode rings, the method of gas injection, and the polarity and strength of a weak vertical magnetic field. Some characteristic data taken under condition when most of the independent variables were optimized are presented. The highest value of the electron number density on the plasma axis is 3.2 x 10 to the 12th power/cc, the highest ion heating efficiency is 47 percent, and the longest particle containment time is 2.0 milliseconds. Author

N77-27920*# Old Dominion Univ., Norfolk, Va. Dept. of Physics and Geophysical Sciences.
X-RAY EMISSION FROM HIGH TEMPERATURE PLASMAS Final Report, 1 Jul. 1974 - 30 Jun. 1977

Wynford L. Harries Jul. 1977 79 p refs
(Grant NsG-1022)
(NASA-CR-153290; PGSTR-PH77-56) Avail: NTIS HC A05/MF A01 CSCL 20I

The physical processes occurring in plasma focus devices were investigated with particular emphasis on X-ray emission. Topics discussed include: trajectories of high energy electrons; detection of ion trajectories; spatial distribution of neutron emission; space and time resolved emission of hard X-rays from a plasma focus; the staged plasma focus as a variation of the hypocloidal pinch; formation of current sheets in a staged plasma focus; and X-ray and neutron emission from a staged plasma focus. The possibility of operating dense plamsa-focus type devices in multiple arrays beyond the scaling law for a single gun is discussed. Author

N77-27921*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF POSSIBLE LOWER HYBRID EMISSION FROM THE NASA LEWIS BUMPY TORUS PLASMA
R. Mallavarpu and J. R. Roth May 1977 16 p refs Presented at the Intern. Conf. on Plasma Sci., Troy, N. Y., 23-25 May 1977; sponsored by IEEE
(NASA-TM-X-73689) Avail: NTIS HC A02/MF A01 CSCL 20I

Radio frequency emission has been detected near the power hybrid frequency of a bumpy torus plasma by using a responsive detection system that consists of a spectrum analyzer and a 50 ohm miniature coaxial antenna concentrically located in a re-entrant quartz tube. The frequency shift of a broad emission peak was monitored as a function of background pressure, electrode voltage, and the strength of the dc magnetic field. Simultaneous measurements of the average plasma density were made with a polarization diplexing microwave interferometer. The information derived from the experiment is discussed with particular reference to the following: (1) whether the emissions are dominated by atomic or molecular species of deuterium; (2) the strength of the dc magnetic field in the emitting region; (3) the geometric location of the emitting region of the plasma; (4) comparison of the lower hybrid plasma density with the average plasma density; and (5) relation of ion spoke geometry to lower hybrid emission. Author

N77-27922# TRW Defense and Space Systems Group, Redondo Beach, Calif.
TRW 25 MW/SUB T/STAGED MHD COAL COMBUSTOR CONCEPTUAL DESIGN STUDY
4 Jun. 1976 363 p refs
(Contract W-31-109-eng-38)
(TID-27145) Avail: NTIS HC A16/MF A01

A 25 MW/sub T/ coal-fired combustor design and development program for MHD application is described. A program plan for the development and testing of the combustor and the scaleability of the design to larger sizes is also presented. ERA

N77-27923# Rocketdyne, Canoga Park, Calif.
MHD COMBUSTOR DESIGN STUDY Final Report
28 May 1976 440 p refs
(Contract W-31-109-eng-38)
(TID-27144; R-9967) Avail: NTIS HC A19/MF A01

The design concept and analysis study, including alternate concepts, are reported for a 25-MW/sub t/ coal-burning combustor that will supply hot gases to an MHD channel. Also included is a program plan for the design, fabrication, development, and testing of the 25-MW/sub t/ combustor and selected components; a test program to be conducted; a cost estimate and schedule for the design, fabrication, and development effort; and an analysis and description of a 2,000-MW/sub t/ coal-burning combustor with the limitations to scaling up to such a combustor size. ERA

N77-27924# Princeton Univ., N. J. Plasma Physics Lab.
FAST-WAVE HEATING OF A REACTOR PLASMA: CONSIDERATION OF TWO FREQUENCY REGIMES
T. H. Stix Oct. 1976 13 p refs Presented at 3d Intern. Symp. on Plasma Physics on Heating in Toroidal Devices, Varenna, Italy, 6 Sep. 1976
(Contract E(11-1)-3073)
(PPPL-1298; Conf-760958-4) Avail: NTIS HC A02/MF A01

Fast-wave heating at omega = n omega/sub ci/, n = 1 or 2, is well suited to heating intermediate-size Tokamaks, but for significantly larger machines, the frequency spectrum becomes thickly packed with these modes. Adequate mode selection could require elaborate antennas; otherwise, mode overlap may produce surface heating of the plasma due to strong near fields at the antennas. The large minor radius and high plasma density in next-generation Tokamaks will accommodate fast-wave toroidal eigenmodes at much longer wavelengths and at frequencies which are well below all the cyclotron frequencies of ions of the fuel gas and of most impurities (carbon, oxygen, iron). Electron transit time and Landau damping provide adequate absorption mechanisms, while the high intrinsic Q of the fast-wave modes will allow strong coupling to the plasma with minimal antenna structures. The low frequency range is also advantageous for coupling together electronic modules to provide several hundred megawatts RF heating power. ERA

N77-27925# California Univ., Berkeley. Lawrence Berkeley Lab.
MIRROR REACTOR BLANKETS
J. D. Lee, W. L. Barmore, D. J. Bender, J. N. Doggett, and T. R. Galloway Mar. 1976 88 p refs Revised
(Contract W-7405-ENG-48)
(UCID-17083-Rev-1) Avail: NTIS HC A05/MF A01

Conceptual design on two blankets was analyzed. The first is for a commercial hybrid (fusion-fission) reactor whose principle product is 239 u. The second is for a commercial power reactor. The fundamental difference between the two blankets is the choice of their principal moderators, uranium for the first and Be for the second. A summary table of parameters for the two blankets is appended. ERA

N77-27926# California Univ., Berkeley. Lawrence Berkeley Lab.
CONCEPTUAL DESIGN STUDY FOR A LASER FUSION HYBRID
J. A. Maniscalco Sep. 1976 20 p refs Presented at 2d Topical Meeting on the Technol. of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976
(Contract W-7405-ENG-48)
(UCRL-78682; Conf-760935-41) Avail: NTIS HC A02/MF A01

Feasibility evaluation was carried out by analyzing the integrated engineering performance of the complete conceptual design and by identifying the required laser/pellet performance. The performance of the laser fusion hybrid has also been compared to a typical fast breeder reactor. The results show that the laser fusion hybrid produces enough fissile material to fuel more than six light water reactors (LWR's) of equivalent thermal power while operating in a regime which requires an order of magnitude less laser and pellet performance than pure laser fusion. In comparison to a fast breeder reactor the hybrid produces 10 times more fissile fuel. An economic analysis of the design shows that the cost of electricity in a combined hybrid-LWR scenario is insensitive to the capital cost of the hybrid, increasing by only 20 to 40 percent when the capital cost of the hybrid ranges from 2 to 3 times more than an LWR. ERA

N77-27927# Illinois Univ., Urbana.
PLASMA HEATING VIA CLAMPING AND CONTROLLED THERMAL RUNAWAY
George H. Miley 1976 23 p refs Presented at the 3d Intern. Symp. on Plasma Heating in Toroidal Devices, Varenna, Italy, 6-17 Sep. 1976
(Contract EY-76-S-02-2218)
(COO-2218-69; Conf-760958-5) Avail: NTIS HC A02/MF A01

Analysis of heating by compression clamping of superthermal ions and also by controlled thermal runaway is described. Applications of clamping to the Tokamak Fusion Test Reactor (TFTR) is considered in some detail. With the injectors presently envisioned for TFTR, sequential injection and clamping give an energy multiplication (Q-value) of order of approximately 0.7. A Q-value over unity is possible, however, if the half-energy component of the injected beam is removed without reduction in input power, and if simultaneous injection and clamping are

possible. Ignition of D-T plasma via clamping followed by a controlled thermal runaway is proposed to ignite a catalyzed-D Tokamak. The plasma composition is gradually changed during the thermal excursion such that the proper D-T-He3 is ultimately achieved. Of the time-temperature trajectories considered for this, the most attractive involves strong clamping followed by a gradual expansion of the radius to control the runaway. ERA

N77-27928# Argonne National Lab., Ill.
EXPERIMENTAL TWO-PHASE LIQUID-METAL MAGNETOHYDRODYNAMIC GENERATOR PROGRAM Annual Report
M. Petrick, G. Fabris, R. Cole, R. Hantman, E. Pierson, and J. Cutting Nov. 1976 102 p refs
(Contract W-31-109-eng-38)
(ANL-ENG-76-04) Avail: NTIS HC A06/MF A01

The generator terminal and internal parameters were measured in a diverging channel liquid metal magnetohydrodynamic generator with gas injection along the insulating walls. Data are given for generator efficiency and load voltages, and the variations along the channel of liquid and gas velocities, pressure, local load factor, void fraction, and slip ratio. Comparisons are made with theoretical predictions. Tests made to evaluate the effectiveness of the gas injection indicated that the generator performance improved slightly as the amount of gas injected was decreased, and that the injected gas was not forming the desired pure-gas wall layer. The gas injection ports were removed, and substantial improvement was obtained in generator performance. Data comparable to that for gas injection is presented for this case. The future directions of the program, including the role of gas injection, and the modifications to the MaK-nitrogen facility are described. ERA

N77-27929# Princeton Univ., N. J. Plasma Physics Lab.
IMPURITY TRANSPORT IN TOKAMAKS
P. H. Rutherford, S. P. Hirshman, R. Jensen, D. E. Post, and F. G. P. Seidl Oct. 1976 21 p refs Presented at the Intern. Symp. on Plasma Wall Interaction, Julich, West Germany, 18-22 Oct. 1976
(Contract E(11-1)-3073)
(PPPL-1297; Conf-761049-2) Avail: NTIS HC A02/MF A01

A review is given of the principle results of the neoclassical theory of impurity transport in the Tokamaks, emphasizing those collisionality regimes of most practical interest. Some new results are given for the case where there are several different impurity species present at the same time with both hydrogenic and impurity ions in the Pfirsch-Schlueter regime. The rate at which an impurity ion is transported into a plasma, and the radiation from it, are strongly dependent on the mean level of ionization (Z). An atomic physics code package, based on an average ion model is used to assess the validity of the coronal equilibrium assumption commonly made to determine (Z); coronal equilibrium is found to be a poor approximation for heavy metallic impurities in small present-day Tokamaks, but its validity is much improved in larger devices, except perhaps in the edge region of the plasma. The computations are compared with the results obtained in an impurity injection experiment in the ATC Tokamak. ERA

N77-27930# Oak Ridge National Lab., Tenn.
MODELS FOR IMPURITY PRODUCTION AND TRANSPORT IN TOKAMAKS
J. T. Hogan 1976 15 p refs Presented at the Intern. Symp. on Plasma Wall Interaction, Julich, West Germany, 18 Oct. 1976
(Contract W-7405-eng-26)
(CONF-761049-1) Avail: NTIS HC A02/MF A01

Models for the edge conditions which are commonly used in Tokamak transport codes have been kept simple partly because of a lack of data. A report is presented on an improved model for the particle and energy balance of e(-), H1i, H10, H2i, H20, O, O/sup (1 yields 8)+/ in the plasma scrape-off region. The diffusion of impurities has been studied with a neoclassical model. The role of anomalous spreading of the impurity distribution has been studied for the case of Fe. A model is presented for the expulsion of low-Z (oxygen) impurities for cases where q(0) is greater than 1, but in which a large shear-free region is produced in the plasma core. ERA

N77-27931# Oak Ridge National Lab., Tenn.
PLASMA STUDIES ON A DUOPIGATRON ION SOURCE
C. C. Tsai, P. M. Ryan, and W. L. Stirling Jan. 1977 28 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5292) Avail: NTIS HC A03/MF A01

In an effort to develop a plasma source capable of producing a dense, quiescent, uniform plasma for extracting tens of amperes of hydrogen ions, experimental and theoretical studies on a duoPIGatron ion source were pursued. A study of plasma generation in the duoPIGatron was begun, and a discharge model was subsequently developed to explain observed source behavior. The discharge model is based on two plasmas, a cathode plasma and a PIG plasma separated by a double layer of ions and electrons, and is similar to the existing model for a duoplasmatron. This discharge model is reviewed, and the importance of the double layer on plasma generation in the duoPIGatron is discussed. Source electrode modifications suggested by the model resulted in a low noise level of about + or -5 percent and a low-density nonuniformity of about + or -10 percent over a 10-cm diameter at a high hydrogen plasma density of roughly 2 x 10 to the 12th power cu cm. ERA

N77-27932# Los Alamos Scientific Lab., N. Mex.
PULSED ENERGY AND SWITCHING REQUIREMENTS FOR TOKAMAK OHMIC HEATING
H. F. Vogel, K. I. Thomassen, W. Bird (Texas Univ., Austin), and F. M. Heck (Westinghouse Electric Corp., Pittsburgh) 1976 8 p refs Presented at IEEE Intern. Pulsed Power Conf., Lubbock, Tex., 9-11 Nov. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2473; Conf-761106-13) Avail: NTIS HC A02/MF A01

The electrical circuit requirements are presented which result from a study of the ohmic-heating system of a Tokamak Experimental Power Reactor (EPR). A computer model for plasma startup was developed as part of an electrical network analysis program. The results of a parametric study are presented in which the pulsed energy and voltsecond-requirements were optimized, electrical machinery was selected, and the switching requirements were defined. ERA

N77-27933# Los Alamos Scientific Lab., N. Mex.
SUPERCONDUCTING MAGNETIC ENERGY STORAGE
John D. Rogers 1976 26 p refs Presented at Pulsed Power Systems Workshop, White Oak, Md., 20 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2047; Conf-760953-1) Avail: NTIS HC A03/MF A01

Fusion power production requires energy storage and transfer on short time scales to create confining magnetic fields and for heating plasmas. The theta pinch Scyllac Fusion Test Reactor (SFTR) requires 480 MJ of energy to drive the 5-T compression field with a 0.7-ms rise time. Tokamak Experimental Power Reactors (EPR) require 1 to 2 GJ of energy with a 1 to 2-s rise time for plasma ohmic heating. The design, development, and testing of four 300-kJ energy storage coils to satisfy the SFTR needs are described. Potential rotating machinery and homopolar energy systems for both the Reference Theta-Pinch Reactor (RTPR) and Tokamak ohmic-heating are presented. ERA

N77-27934# California Univ., Livermore. Lawrence Livermore Lab.
COMPUTER SIMULATION OF THE CREATION OF A TRANSIENT, HIGH DENSITY PLASMA BY CONVERGENT NEUTRAL BEAMS
C. J. Eggens (Hartman) 1 Jun. 1976 60 p refs
(Contract W-7405-eng-48)
(UCRL-52055) Avail: NTIS HC A04/MF A01

A formula is given for accurately predicting the geometrical convergence and temporal bunching of converging neutral beams. The number densities and degree of ionization of the neutral distribution as the beams approach convergence are calculated for spherical and cylindrical geometries. The distribution functions obtained from a mathematical model are numerically integrated to obtain particle densities. Values of the ionization rate parameter anti sigma v/sub NN/ are similarly obtained using numerical fits to the neutral-neutral ionization cross section data.

Integration of the resulting ionization rate provides a first-order estimate of the ion density n/sub I/ as a function of space and time. A better calculation of n/sub I/ is then obtained by adding the second-order effects of neutral-ion collisions. It is thereby possible to determine whether the distribution will be significantly ionized before it has completely converged. ERA

N77-27935# California Univ., Livermore. Lawrence Livermore Lab.

HOLOGRAPHIC INTERFEROMETRY OF LASER FUSION TARGETS AT 2660 ANGSTROMS

L. W. Coleman, D. T. Attwood, and D. W. Sweeney Sep. 1976 8 p refs Presented at the Plasma Phys. Meeting of the Am. Phys. Soc., San Francisco, 15-19 Nov. 1976

(Contract W-7405-eng-48)

(UCRL-78429; Conf-761108-12) Avail: NTIS HC A02/MF A01

Holographic interferometry at 2,600 A has been used to study plasma blowoff from 80 micron diameter laser fusion targets. Scale lengths of 11 microns, measured with 1 micron spatial resolution, are recorded at 7x 10 sup 20e/cc after 800 psec of hydrodynamic expansion. These results suggest much steeper density gradients at peak irradiation intensity. The observed fringe pattern is strongly dependent on interferometric imaging, as expected for strong transverse gradient refractive media. Significant interpretive errors, which might occur in a single image classical interferometer, are avoided with this holographic technique. ERA

N77-27936# California Univ., Livermore. Lawrence Livermore Lab.

LASER FUSION EXPERIMENTS AT 2 TW

E. K. Storm, H. G. Ahlstrom, M. J. Boyle, L. W. Coleman, H. N. Kornblum, R. A. Lerche, D. R. MacQuigg, D. W. Phillion, F. Rainer, and V. C. Rupert 1 Oct. 1976 30 p refs Presented at the Plasma Phys. Meeting of the Am. Phys. Soc., San Francisco, 15-19 Nov. 1976

(Contract W-7405-eng-48)

(UCRL-78581-Rev-1; Conf-761108-20) Avail: NTIS HC A03/MF A01

The Lawrence Livermore Laboratory Solid State Laser System, Argus, has successfully performed laser implosion experiments at power levels exceeding 2 TW. D-T filled glass microspheres have been imploded to yield thermonuclear reaction products in excess of 5 x 10 to the 8th power per event. Neutron and alpha time-of-flight measurements indicate that D-T ion temperatures of approximately 5 to 6 keV and a density confinement time product (n tau) of approximately 10 to the 12th power were obtained in these experiments. Typically two 40J, 40 psec pulses of 1.06 microns light were focused on targets using 20 cm aperture f/1 lenses, producing intensities at the target in excess of 10 to the 16th power W/sq cm. An extensive array of diagnostics routinely monitored the laser performance and the laser target interaction process. Measurements of absorption and asymmetry in both the scattered light distribution and the ion blow off is evidence for nonclassical absorption mechanisms and density scale heights of the order of 2 microns or less. The symmetry of the thermonuclear burn region is investigated by monitoring the alpha particle flux in several directions, and an experiment to image the thermonuclear burn region is in process. These experiments significantly extend our data base and our understanding of laser induced thermonuclear implosions and the basic laser plasma interaction physics from the 0.4 to 0.7 TW level of previous experiments. ERA

N77-27937# California Univ., Livermore. Lawrence Livermore Lab.

LASER FUSION BURN DIAGNOSTICS USING SEVERAL ALPHA-TIME-OF-FLIGHT SPECTROMETERS, REVISION 1

K. G. Tirsell, H. C. Catron, S. S. Glaros, and V. W. Slivinsky 30 Sep. 1976 29 p refs Presented at Plasma Phys. Meeting of the Am. Phys. Soc., San Francisco, 15-19 Nov. 1976

(Contract W-7405-eng-48)

(UCRL-78487-Rev-1; Conf-761108-19) Avail: NTIS HC A03/MF A01

A more compact alpha particle time-of-flight spectrometer using a permanent field deflection magnet was developed for laser fusion burn diagnostics. The spectrometer is being used to measure the number and energy distribution of fusion-produced alpha particles emitted from laser implosions of DT gas contained in glass microshells. It is planned to view the target from different angles using several spectrometers simultaneously. Comparison of energy loss and energy broadening vs angle can yield information concerning the nature of compression and subsequent burn. Results from target experiments on the LLL ARGUS laser facility are presented. ERA

N77-27938# California Univ., Livermore. Lawrence Livermore Lab.

PLASMA FLOWS IN THE CONDUCTION REGION OF A SPHERICAL LASER TARGET

C. E. Max, C. F. McKee, and W. C. Mead 21 Oct. 1976 22 p refs Presented at 18th Ann. Meeting of the Am. Phys. Soc., Div. of Plasma Phys., San Francisco, 15-19 Nov. 1976

(Contract W-7405-eng-48)

(UCRL-78458; Conf-761108-22) Avail: NTIS HC A02/MF A01

Analytic solutions are derived for plasma flows in a spherical laser target, emphasizing the region which lies between the ablation surface and the critical density surface. Electron thermal conductivity dominates the heat transport in this zone. Both classical electron thermal conduction and flux-limited conduction are treated in which the finite electron thermal velocity provides an upper bound to the heat flux. These analytic solutions are compared with computational results from 1-D hydrodynamics calculations. Finally, the implications of these solutions for growth rates of plasma instabilities in the conduction region are considered. ERA

N77-27939# California Univ., Livermore. Lawrence Livermore Lab.

MEASUREMENT OF HIGH ENERGY IONS

Stanley S. Glaros, Kenneth G. Tirsell, Viviane C. Rupert, Henry C. Catron, and Vincent W. Slivinsky 9 Nov. 1976 22 p refs Presented at the Plasma Meeting of the Am. Phys. Soc., San Francisco, 15-19 Nov. 1976

(Contract W-7405-eng-48)

(UCRL-78427-Rev-1; Conf-761108-17) Avail: NTIS HC A02/MF A01

The current interest in fast ions has prompted the design of a time of flight ion spectrometer which measures the high energy ions from a laser produced plasma. A magnet was used to separate the ions from the intense background of electrons, X rays, and scattered light. The design of the instrument is wide band so that ions with energies 0.03 to 3,000 keV/amu can be measured. Results from target experiments on the LLL ARGUS laser facility are presented. The fast ion spectrum is dovetailed with the spectrum of the slower ions collected by Faraday cups and thus provides a measurement for the total energy carried by ions. The charge to mass ratio of the ions can be calculated from the spectrometer output. ERA

N77-27940# California Univ., Livermore. Lawrence Livermore Lab.

X-RAY INSTRUMENTATION IN THE LLL LASER-FUSION PROGRAM

Louis N. Koppel 23 Jun. 1976 25 p refs Presented at the 20th Ann. SPIE Tech. Symp., San Diego, Calif., 24 Aug. 1976

(Contract W-7405-eng-48)

(UCRL-78084; Conf-760832-22) Avail: NTIS HC A02/MF A01

Conventional X-ray diagnostic techniques do not provide sufficiently high spectral, spatial, and temporal resolution for measuring the distribution of soft X-ray pulses (.2 to 10 keV) radiated by laser-induced plasmas. Advances in X-ray instrument development described include: (1) wavelength-dispersive spectrographs with fractional-electron volt resolution at several keV and imaging systems with 3 micron resolution over a 100 micron source, (2) advanced solid state X-ray sensors that recover data from these instruments in a more expedient manner than photographic film, (3) microcomputer-controlled stand-alone spectrograph data systems and minicomputer-based integrated systems that can deal with the large array of data generated by the high resolution instruments, and (4) spectral and spatial resolution and a timing resolution of better than 15 ps. ERA

N77-27941# Argonne National Lab., Ill.
SURFACE EROSION PHENOMENA IN CONNECTION WITH CTR APPLICATIONS
M. Kaminsky and S. K. Das 1976 9 p refs Presented at the 4th Conf. on Appl. of Small Accelerators, Denton, Texas, 25-27 Oct. 1976
(Contract W-31-109-eng-38)
(CONF-761059-16) Avail: NTIS HC A02/MF A01

The interaction of plasma radiations with the exposed surfaces of components of plasma devices and future controlled thermonuclear fusion reactors (CTR) can cause a variety of surface effects. In turn, such surface effects can cause (1) the release of plasma contaminants, and (2) the damage and erosion of the irradiated surfaces. The contamination of the plasma can have serious effects on plasma stability and on plasma temperature, and the surface erosion can seriously limit the lifetime of the irradiated components. At present, knowledge of surface erosion rates for the plasma parameters and materials envisioned in CTR applications is only fragmentary. A summary of some of the major surface erosion phenomena which have been identified as being important for CTR applications by using single irradiation sources (e.g., accelerators) will be given. A discussion of some potential solutions to reduce surface erosion will be included. The main features of a recently completed two component irradiation facility at ANL for CTR related surface studies will be described. ERA

N77-27942# Battelle Pacific Northwest Labs., Richland, Wash.
TRITIUM PRODUCTION FROM CERAMIC TARGETS: A SUMMARY OF THE HANFORD COPRODUCT PROGRAM
A. B. Johnson, Jr., T. J. Kabele, and W. E. Gurwell Aug. 1976 142 p refs
(Contract E(45-1)-1830)
(BNWL-2097) Avail: NTIS HC A07/MF A01

Early generation fusion reactors require tritium breeding from lithium compounds. Some current fusion reactor conceptual designs specify ceramic lithium compounds (lithium aluminate, lithium silicate, lithium oxide) for blanket materials. One potential source of information is the technology developed in support of large scale tritium production programs in fission reactors. Recent declassification of documents containing information no longer regarded as sensitive provides much information of potential value to fusion reactor designers. The tritium production technology developed at Hanford in the mid-1960s is summarized. Information of potential value to the fusion community has been extracted from declassified and unclassified reports, summarized, and referenced. ERA

N77-27943# Argonne National Lab., Ill.
TOKAMAK EXPERIMENTAL POWER REACTOR
W. M. Stacey, Jr., M. A. Abdou, P. J. Bertoncini, C. C. Bolta, J. N. Brooks, K. Evans, Jr., J. A. Fasolo, J. C. Jung, R. L. Kustom, V. A. Maroni et al Oct. 1976 27 p refs Presented at 2d Topical Meeting on Technol. of Controlled Nucl. Fusion, Richland, Wash., 21-23 Sep. 1976
(Contract W-31-109-eng-38)
(CONF-760935-50) Avail: NTIS HC A03/MF A01

A conceptual design was developed for a Tokamak Experimental Power Reactor to operate at net electrical power conditions with a plant capacity factor of 50 percent for 10 yrs. The EPR operates in a pulsed mode at a frequency of approximate 1/min, with an approximately 75 percent duty cycle, is capable of producing approximately 72 MWe and requires 42 MWe. The EPR vacuum chamber is 6.25 m in major radius and 2.4 m in minor radius, and is constructed of 2 cm thick stainless steel, and has 2 cm thick detachable, beryllium-coated coolant panels mounted on the interior. A 0.28 steel blanket and a shield ranging from 0.6 to 1.0 m surround the vacuum vessel. Sixteen niobium-titanium superconducting toroidal field coils provide a field of 10 T at the coil and 4.47 T at the plasma. Superconducting ohmic heating and equilibrium field coils provide 135 V-s to drive the plasma current. Plasma heating is accomplished by 12 neutral beam injectors which provide 60 MW. ERA

N77-27944# Sandia Labs., Albuquerque, N. Mex.
SPACE-CHARGE FLOW IN A NON-CYLINDRICALLY SYMMETRIC DIODE
J. P. Quintenz and J. W. Poukey 1976 6 p refs Presented at IEEE Intern. Pulsed Power Conf., Lubbock, Tex., 9 Nov. 1976
(Contract E(29-1)-789)
(SAND-76-5750; Conf-761106-1) Avail: NTIS HC A02/MF A01

The one dimensional cylindrical space charge limited emission and flow results of Langmuir and Blodgett are extended to the two dimensional (r-theta) non-symmetric case by solving a fluid model numerically. It is found that particle beams thus generated can be controlled by suitable adjustment of the applied potentials and cylinder radii. A particle code was modified to treat razor blade cathodes by including a simplified model for the blade emission. Numerical results are compared with experimental data. These results indicate that beams produced by razor blades pinch less tightly than those from block cathodes, but in some cases may still pinch enough to be interesting. ERA

N77-27945# Argonne National Lab., Ill.
CONCEPTUAL DESIGN OF SUPERCONDUCTING MAGNET SYSTEMS FOR THE ARGONNE TOKAMAK EXPERIMENTAL POWER REACTOR
S. T. Wang, L. R. Turner, F. E. Mills, D. W. DeMichele, P. Smelser, and S. H. Kim 1976 20 p Presented at 2nd topical meeting on the Technol. of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976
(Contract W-31-109-eng-38)
(CONF-760935-53) Avail: NTIS HC A02/MF A01

The conceptual design of a 10-tesla, pure-tension superconducting toroidal field (TF) coil system was developed in sufficient detail to define a realistic design for the TF coil system that could be built based upon the current state of technology with minimum technological extrapolations. A conceptual design study on the superconducting ohmic heating (OH) coils and the superconducting equilibrium field (EF) coils were also completed. These conceptual designs are developed in sufficient detail with clear information on high current ac conductor design, cooling, venting provision, coil structural support and zero loss poloidal coil cryostat design. The EF penetration into the blanket and shield was also investigated. ERA

N77-27946# Argonne National Lab., Ill.
TOKAMAK EXPERIMENTAL POWER REACTOR
W. M. Stacey, Jr., M. A. Abdou, and P. J. Bertoncini 1976 21 p Presented at Ann. meeting of the Amer. Soc. of Mech. Eng., New York, 29 Nov. 1976
(Contract W-31-109-eng-38)
(CONF-761107-23) Avail: NTIS HC A02/MF A01

A Tokamak experimental power reactor designed to operate at net electrical power conditions with a plant capacity factor of 50 percent for 10 yrs operates in a pulsed mode at a frequency of approximately 1/min, with approximately 75 percent duty cycle, and is capable of producing approximately 72 MWe. Annual tritium consumption is 16 kg. The stainless steel vacuum chamber has beryllium coated coolant panels mounted on the interior and is surrounded by a stainless steel blanket and shield. The coolant is H20. Sixteen niobium-titanium superconducting toroidal field coils provide a field of 10 T at the coil and 4.47 at the plasma. Plasma current is driven by superconducting ohmic heating and equilibrium field coils. Plasma heating is accomplished by 12 neutral beam injectors which provide 60 MW. The energy transfer and storage system consists of a central superconducting storage ring, a homopolar energy storage unit, and a variety of inductor-convertors. ERA

N77-27947# Oak Ridge National Lab., Tenn.
STRUCTURAL MATERIALS FOR LARGE SUPERCONDUCTING MAGNETS FOR TOKAMAKS
C. J. Long Dec. 1976 51 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5632) Avail: NTIS HC A04/MF A01

The selection of structural materials for large superconducting magnets for Tokamak-type fusion reactors is considered. The important criteria are working stress, radiation resistance, electro-magnetic interaction, and general feasibility. The most advantageous materials appear to be face-centered-cubic alloys in the Fe-Ni-Cr system, but high-modulus composites may be necessary where severe pulsed magnetic fields are present. Special-purpose structural materials are considered briefly. ERA

N77-27948# Princeton Univ., N. J. Plasma Physics Lab.
STUDY OF DRIFT WAVE TURBULENCE BY MICROWAVE SCATTERING IN A TOROIDAL PLASMA
M. Okabayashi and V. Arunasalam Jan. 1977 45 p refs
(Contract E(11-1)-3073)
(PPPL-1310) Avail: NTIS HC A03/MF A01

A study of drift wave turbulence by microwave scattering technique was carried out in a toroidal plasma confinement device, the FM-1 spherator. The principal results are; (1) observation of the linear dispersion relation of drift waves in the high magnetic shear condition; the linear dispersion relation is followed up to weak turbulence state (gamma approximately less than omega) (2) an experimental demonstration of the stabilization of the drift waves with an increase of the shear strength, in particular, the ion mass dependence of the observed marginal stability criterion for drift waves (omega approximately omega/sub */) was in reasonably good agreement with theoretical expectations. Further, very low frequency (omega much less than omega sub */) fluctuations were enhanced when the shear strength was lowered. (3) a detailed study of the behavior of drift waves in a weak shear condition where a state of isotropic turbulence was observed; the turbulent density fluctuations showed a strong dependence on frequency, but no dependence on wave number (somewhat in sharp contrast to theoretical expectations). The possible dependence of the anomalous loss process on the observed drift wave turbulence is also discussed. ERA

N77-27949# Illinois Univ., Urbana.
DESTABILIZING EFFECT OF ALPHA PARTICLES IN A MAXWELLIAN PLASMA M. S. Thesis
M. Y. Wang 1976 53 p refs
(COO-2218-70) Avail: NTIS HC A04/MF A01

Various plasma waves which are possibly excited by MeV alphas have been investigated. For a delta birth distribution it is found that: (1) The right-circularly polarized Alfven wave can be excited. Its growth rate is linearly proportional to the alpha-particle density. (2) The drift Alfven wave is stable against alpha-particles. (3) For a uniform temperature, the plasma wave spectrum changes from three branches with n/sub alpha/= 0 to four branches for n/sub/alpha/not equal to 0 case. (4) alpha-particles can destabilize the ion drift acoustic wave even with uniform temperature. However, the ion acoustic wave appears to be stable against fusion products in a fusion grade plasma. (5) If their effect on the background plasma spectrum is neglected alpha-particles can excite the electromagnetic cyclotron wave in a range of harmonics (band structure). The growth rate is proportional to the square root of alpha-particle density. (6) If the effect of alpha-particle on the plasma spectrum is included, it is found that electromagnetic cyclotron wave is stable. ERA

N77-27950# Kanner (Leo) Associates, Redwood City, Calif.
FORMATION OF A FAST ELECTRON CLOUD BY INJECTING A HIGH POWER RELATIVISTIC ELECTRON BEAM IN A VACUUM
D. D. Ryutov and G. V. Stupakov 1977 25 p refs Transl. into ENGLISH of Russian Report, IYaF-75-111, 1977 25 p Prepared for Los Alamos Scientific Lab.
(Contract W-7403-eng-36)
(LA-tr-77-1) Avail: NTIS HC A02/MF A01

An analytical description is given of the dynamics of forming a relativistic electron cloud which arises near the anode foil of a high power electron accelerator. It is shown that under certain conditions the density of the cloud can exceed the density of the original relativistic beam by two to three orders of magnitude. ERA

N77-27951# Atomic Energy Organization of Iran, Teheran. Nuclear Research Center.
FUSION. THE FUTURE ENERGY SOURCE
1976 71 p refs In PERSIAN
(AEOI-10; NRC-76-7) Avail: NTIS MF A01; INIS Section, International Atomic Energy Agency, P. O. Box 590 A-1011, Vienna, Austria

It is proposed that Iran as a world's potential supplier of fossil fuel should participate in fusion research and gain experience in this new field. Fusion, as an ultimate source of energy in the future, and the problems concerned with the fusion reactors are reviewed. Furthermore, plasma heating and magnetic and inertial confinement in a fusion reactor are discussed. A brief description of Tokamak, theta pinch and magnetic mirror reactors is also included. ERA

N77-27952# Los Alamos Scientific Lab., N. Mex.
KINETIC APPROACH TO PLASMA END LOSS FROM LINEAR DEVICES
H. Dreicer 1976 28 p refs Presented at 3rd Symp. on Plasma Heating in Toroidal Devices, Varenna, Italy, 6-17 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2010; Conf-760958-3) Avail: NTIS HC A03/MF A01

A first step in the direction of a kinetic approach to end loss has been presented. This approach brings to light some fundamental processes not uncovered by the magnetohydrodynamic or guiding center approach. Attenuation was focused on the basically transient phenomenon in a way that describes the quite different behavior of collision dominated and collisionless ions, but ignores the magnetic nozzle effects near the ends of the systems. The treatment illuminates some of the roles played by the parameter 1/sub ii/L, and suggests the direction for more detailed investigations. End loss from linear systems is a very many faceted problem. Kinetic effects, magnetic effects, heat flow, etc. are all intermixed, and it will require a strong long term experimental and theoretical program to unravel all of its mysteries. ERA

N77-27953# Princeton Univ., N. J. Plasma Physics Lab.
ICRF HEATING IN LARGE TOKAMAKS
J. C. Hosea Nov. 1976 18 p refs Presented at 3rd Symp. and Workshop on Plasma Heating in Toroidal Devices, Varenna, Italy, Sep. 1976
(Contract E(11-1)-3073)
(PPPL-1309; Conf-760958-6) Avail: NTIS HC A02/MF A01

When projected to PLT-size Tokamaks, the preliminary results for omega approximately 2 omega/sub ci/fast wave heating obtained in the ST and ATC Tokamaks indicate that very efficient heating of the central plasma region as opposed to the surface region should ensue when the RF energy is suitably coupled to the plasma waves. Ion banana orbit losses become negligible and a large number of propagating waves are available so that the radial RF energy disposition pattern can be properly selected at last. It is vital to the potential use of ICRF (Ion Cyclotron Range of Frequencies) heating in reactor scale plasmas that surface heating be controlled and minimized relative to heating the plasma core. A demonstration that this is possible in existing large Tokamaks is essential to the development of the ICRF heating schemes for reactor use. Projections to TFTR and larger devices are considered briefly. ERA

N77-27954# General Atomic Co., San Diego, Calif.
THEORY OF PLASMA CONFINEMENT IN TOKAMAKS OF NONCIRCULAR CROSS SECTION AND OPTIMIZATION OF THE DOUBLET III DESIGN
M. S. Chu, D. R. Dobrott, G. E. Guest, F. J. Helton, T. H. Jensen, J. L. Luxon, R. L. Miller, T. Ohkawa, J. M. Rawls, T. S. Wang et al 23 Aug. 1976 15 p refs Presented at 6th Intern. Conf. on Plasma Phys. and Controlled Nucl. Fusion. Res., Berchtesgaden, West Germany, 6-13 Oct. 1976
(Contract E(04-3)-0167)
(GA-A-14092; Conf-761012-36; IAEA-CN-35/B11-1) Avail: NTIS HC A02/MF A01

Equilibria are analyzed in the ideal MHD theory using free-boundary numerical techniques and a wide range of models of the diffuse plasma pressure and current. The plasma cross-sectional shape is studied as the current profile and external shaping flux are varied. Arrays of field-shaping coils (F coils) to produce the desired 3:1 vertically-elongated doublet are tested with this computational model. The gross stability of noncircular Tokamaks was studied extensively using variational techniques. Axisymmetric modes, expected to occur in vertically-elongated plasma columns, are found to be stabilized if conducting walls are near enough to the plasma surface. Ideal and resistive criteria for the stability of localized interchange modes have been used to evaluate the maximum plasma pressure (and current) that can be stably confined in plasmas of varying cross-sectional shapes. Doublet- and dee-shaped Tokamaks are stable at

sufficiently high plasma pressures to suggest that interchange need not be the limiting phenomenon. ERA

N77-27955# Science Applications, Inc., Boulder, Colo. Lab. for Applied Plasma Studies.

RADIATION COUPLING OF BERNSTEIN MODES IN A RING PLASMA

J. M. Hoffman and R. E. Aamodt Oct. 1976 35 p refs
(Contracts E(04-3)-1018; EY-76-S-02-2081)
(SAI-76-792-LJ; LAPS-78) Avail: NTIS HC A03/MF A01

Motivated by the observation of anomalously intense radiation at frequencies sharply peaked about the electron cyclotron harmonics, the behavior of high frequency flute modes in a weakly inhomogeneous magnetoplasma is investigated. The longitudinal approximation is eschewed, and the coupling of Bernstein modes with electromagnetic modes is analyzed. A graphical method is described for visualizing the salient features of mode behavior in this inhomogeneous plasma, and a highly resonant coupling instability is proposed as the energy generating mechanism for the radiation. ERA

N77-27956# California Univ., Livermore. Lawrence Livermore Lab.

BEAM DIAGNOSTICS ON ARGUS

D. R. MacQuigg and D. R. Speck 22 Sep. 1976 37 p refs Presented at Plasma Phys. Meeting of the Am. Physical Soc., San Francisco, Calif., 15 Nov. 1976
(Contract W-7405-eng-48)
(UCRL-78447; Conf-761108-15) Avail: NTIS HC A03/MF A01

Performance of laser fusion targets depends critically on the characteristics of the incident beam. The spatial distribution and temporal behavior of the light incident on the target varies significantly with power, with choice of beam spatial profile and with location of spatial filters. On each ARGUS shot, planes in the incident beams which are equivalent to the target plane are photographed. Array cameras record the time integrated energy distributions and streak cameras record the temporal behavior. Computer reduction of the photographic data provides detailed spatial energy distributions, and instantaneous power on target vs. time. Target performance correlates with the observed beam characteristics. ERA

N77-27957# California Univ., Livermore. Lawrence Livermore Lab.

SCATTERED LIGHT EVIDENCE FOR SHORT DENSITY HEIGHTS NEAR CRITICAL DENSITY IN LASER-IRRADIATED PLASMAS

D. W. Phillion, R. A. Lerche, V. C. Rupert, R. A. Haas, and M. J. Boyle 15 Sep. 1976 27 p refs Presented at Plasma Phys. Meeting of Am. Phys. Soc., San Francisco, 15-19 Nov. 1976 Revised
(Contract W-7405-eng-48)
(UCRL-78444-Rev-1; Conf-761108-9) Avail: NTIS HC A03/MF A01

Experimental evidence is presented of a steepened electron density profile near critical density obtained from studying the time-integrated scattered light from targets illuminated by linearly polarized, 1.06 microns light. Both 10 microns thick disks and DT-filled glass imcro-shells were irradiated by light focused by f/1 or f/2.5 lenses in one and two-beam experiments, respectively. From the dependence of the asymmetry of the scattered light about the beam axis upon the scattering angle, scale lengths on the order of one micron are inferred. Scale lengths have also been deduced from measurements on the polarization state of the reflected light. Both analytic and numerical results are presented to show how the polarization state varies with the incidence angle and the scale length. ERA

N77-27958# California Univ., Livermore. Lawrence Livermore Lab.

PARTICLE AND X-RAY ENERGY MEASUREMENTS IN LASER-PLASMA INTERACTION EXPERIMENTS

V. C. Rupert, S. R. Gunn, J. F. Holzrichter, S. S. Glaros, J. R. Severyn, and P. Lee 24 Sep. 1976 41 p refs Presented at Plasma Phys. Meeting of the Amer. Phys. Soc., San Francisco, Calif., 15 Nov. 1976
(Contract W-7405-eng-48)
(UCRL-78439; Conf-761108) Avail: NTIS HC A03/MF A01

The energy carried by particles and low energy X-rays resulting from irradiation of targets with .5 to 1 TW, 1.06 micron lasers was measured. The energy distributions were obtained from measurements at discrete locations using calorimeters; work is in progress to obtain them over a hemisphere with a thermal imaging system. Aximuthal symmetry and polar distributions for different focusing schemes were determined. The data were integrated to obtain the absorbed energy, and these values compared to box calorimetry and optical energy balance. The relative emission of low energy X-rays from different Z materials can be obtained by comparing these data to charge collector data. Such comparisons show that the effective ion charge can be as low as a factor of two below the completely ionized state. The existence of low charge state ions was confirmed with high resolution spectrometers. ERA

N77-27959# California Univ., Livermore. Lawrence Livermore Lab.

INSTRUMENTATION FOR MEASURING SOFT X-RAYS FROM LASER PRODUCED PLASMAS

V. W. Slivinsky, H. G. Ahlstrom, H. N. Kornblum, L. N. Koppel, and G. R. Leipelt 24 Sep. 1976 16 p refs Presented at European Conf. on Laser Interaction with Matter, Palaiseau, France, 18 Oct. 1976
(Contract W-7405-eng-48)
(UCRL-77994; Conf-761025-1) Avail: NTIS HC A02/MF A01

Measurements of subkilovolt X-rays from laser-produced plasmas are needed to do a complete energy balance on laser fusion experiments. The instruments used must have thin windows and yet discriminate against the severe environment of other intense target emissions such as ions, electrons, and scattered laser light. Low energy X-ray measurements down to 0.1 keV are presented using these absolutely calibrated detectors on laser target shots with the LLL Terawatt laser facility, Cyclops. Precautions in using these detectors in a laser fusion target chamber are enumerated. ERA

N77-27960# California Univ., Livermore. Lawrence Livermore Lab.

FIRST WALL STUDIES OF A LASER-FUSION HYBRID REACTOR DESIGN

Jack Hovingh Sep. 1976 21 p refs Presented for the Proc. of the 2d ANS Topical Meeting on the Technol. of Controlled Nucl. Fusion, Richland, Wash., 21-23 Sep. 1976
(Contract W-7405-eng-48)
(UCRL-78090; Conf-760935-44) Avail: NTIS HC A02/MF A01

The design of a first wall for a 20 MW thermonuclear power laser fusion hybrid reactor is presented. The 20 mm thick graphite first wall is located 3.5 m from the DT microexplosion with a thermonuclear yield of 10 MJ. Estimates of the energy deposition, temperature, stresses, and material vaporized from the first wall due to the interaction of the X-rays, charged particle debris, and reflected laser light with the graphite are presented, along with a brief description of the analytical methods used for these estimations. Graphite is a viable first wall material for inertially-confined fusion reactors, with lifetimes of a year possible. ERA

N77-27961# Columbia Univ., New York. Plasma Physics Lab.

PLASMA-WALL INTERACTIONS

R. A. Gross, B. Jensen, J. K. Tien, and N. Panayotou 1976 8 p refs Presented at the Intern. Symp. on Plasma Wall Interaction, Juelich, West Germany, 18-22 Oct. 1976
(Contract E(11-1)-2456)
(CONF-761049-3) Avail: NTIS HC A02/MF A01

Phenomena occurring when a hot dense plasma containing a transverse magnetic field is brought into sudden contact with a cold metal wall were investigated. Computational simulation was used to study the physics of the fusion plasma boundary layer which forms at the plasma-wall interface. The rate of energy transfer to the metal wall is computed and compared with experimental data. Candidate fusion-reactor first wall materials were exposed repeatedly to a warm deuterium plasma containing a transverse magnetic field and subjected to the energy flux expected at the first wall in about one year operation of a

Tokamak fusion power reactor. Stainless steels show erosion at grain boundaries, formation of deuterium blisters on the surface evidence of surface melting to a depth of 25 micron and rapid resolidification. Some cracking is observed, and decrease in tensile ductility is measured. ERA

N77-27962# California Univ., Livermore. Lawrence Livermore Lab.
PLASMA EXPERIMENTS WITH 1.06 MICRONS LASERS AT THE LAWRENCE LIVERMORE LABORATORY
H. G. Ahlstrom, J. F. Holzrichter, K. R. Manes, E. K. Storm, R. A. Haas, D. W. Phillion, V. C. Rupert, M. J. Boyle, and K. M. Brooks 19 Sep. 1976 56 p refs Presented at the European Conf. on Laser Interaction with Matter, Palaiseau, France, 18-22 Oct. 1976
(Contract W-7405-eng-48)
(UCRL-77943-Rev-1; Conf-761025-8) Avail: NTIS HC A04/MF A01

Irradiation experiments were performed with the two beam Nd:YAG glass laser systems, Janus, Cyclops, and Argus. Two classes of targets were used, glass microshells filled with an equimolar DT mixture and disks of several compositions. The targets were supported in vacuum by thin glass stalks. Results related to the propagation, absorption, and scattering of laser light by both spherical and planar targets are reported. The absorption measurements cannot be explained using only inverse Bremsstrahlung. The scattered light and the plasma energy are polarization dependent, which is evidence of resonance absorption. The X-ray spectra are characterized by a thermal and a suprathermal distribution. ERA

N77-27963# Illinois Univ., Urbana.
EXPERIENCES WITH PROJECT-ORIENTED RESEARCH IN GRADUATE ENGINEERING EDUCATION
George H. Miley 1976 4 p refs Presented at Frontiers in Educ. Conf., Tucson, Ariz., 25 Oct. 1976
(Contract E(11-1)-2218)
(COO-2218-77; Conf-761042-1) Avail: NTIS HC A02/MF A01

Two examples of project-oriented research that involve the conceptual design of fusion systems are described. One of these projects involved close collaboration with workers in a national laboratory while the second was formally organized as a cooperative effort with two other laboratories. An important educational aspect of such research is that the students are involved in a design team composed of both students and professionals facing a realistic problem. In retrospect, it appears that both students and faculty profited from the experience. Several students have taken jobs in related areas, and additional research has resulted from new insight gained during the projects. ERA

N77-27964# Princeton Univ., N. J. Plasma Physics Lab.
RADIAL BOUNDARY LAYERS IN DIFFUSING TOROIDAL EQUILIBRIA
M. D. Rosen and J. M. Greene Jan. 1977 45 p
(Contract E(11-1)-3073)
(PPPL-1315) Avail: NTIS HC A03/MF A01

Analytic results in straight cylindrical geometry imply sharp density gradients near the boundary of a plasma decaying by classical diffusion. Utilizing an isothermal one-fluid magnetohydrodynamic model, these results are applied to toroidal configurations and a set of nonlinear equations for a radial boundary layer is obtained. A dominant effect in this regime is convective plasma flow along magnetic lines of force, with velocity in the sonic range. This flow pattern matches onto the interior solution of Pfirsch-Schlueter convective flow. Solutions separable in the radial and poloidal directions are found that fulfill both boundary and periodicity conditions, and that result in both smooth subsonic poloidal flow, and weak shock transonic flows. Effects of the flow patterns on diffusion are discussed. ERA

N77-27965# Energy Research and Development Administration, Washington, D.C.
NEGATIVE ION SOURCE FOR OBTAINING TUBULAR BEAMS
V. L. Komarov and A. P. Strokach 1976 10 p refs Transl. into ENGLISH of Russian Preprint D-0282
(ERDA-TR-237; D-0282) Avail: NTIS HC A02/MF A01

Experiments on the investigation of a surface-plasma negative ion source with a ring discharge chamber operating on hydrogen having cesium vapors are described. The region of stable uniform burning of 80 mm dia plasma-ring discharge in crossed fields (ExH) within the pressure range of 0.1 to 1 Torr is shown. Emission characteristics depending on the source different parameters are given. The investigation of uniformity of plasma-ring discharge burning as well as the definition of the source emission characteristics was accomplished with six 0.3 mm dia holes located through 60 deg in the ring anode. Current emission density of hydrogen negative ions up to 1.2 a/sq cm was obtained from the source. Current ratio of accompanying electrons and H(-) ion was about 2. ERA

N77-27966# Battelle Pacific Northwest Labs., Richland, Wash.
REFERENCE COMMERCIAL FUSION POWER PLANTS
J. R. Young and B. F. Gore Sep. 1976 72 p refs
(Contract EY-76-C-06-1830)
(BNWL-2014) Avail: NTIS HC A04/MF A01

Currently available conceptual designs for commercial fusion power plants are for first generation plants using deuterium-tritium (D-T) fuel, and are all functionally similar. This similarity has been used as a basis for defining an envelope of D-T fusion power plant characteristics which encompasses the charcteristics of the available designs. A description of this envelope, including general process descriptions, proposed materials uses, and a tabulation of numerical ranges of plant parameters is presented in this document. ERA

N77-27967# California Univ., Livermore. Lawrence Livermore Lab.
CALORIMETERS FOR DIAGNOSIS OF LASER-FUSION EXPERIMENTS
S. R. Gunn 25 Oct. 1976 43 p refs
(Contract W-7405-eng-48)
(UCID-17308) Avail: NTIS HC A03/MF A01

A variety of calorimeters were developed for measuring ions, X-rays, and scattered radiation emanating from laser-pulse-imploded fusion targets. The ion and X-ray calorimeters use metal or glass absorbers to reflect or transmit most of the scattered laser radiation; the versions using metal absorbers also incorporate a differential construction to compensate for the fraction of the scattered laser radiation that is absorbed. The scattered-radiation calorimeters use colored glass to absorb the radiation and a transparent glass shield to remove ions and X-rays. Most of the calorimeters use commercial semiconductor thermoelectric modules as the temperature sensors. ERA

N77-27968# United Kingdom Atomic Energy Authority, Culham (England).
DIELECTRONIC RECOMBINATION IN LASER GENERATED PLASMAS
T. P. Donaldson Mar. 1976 30 p refs
(CLM-R-153) Avail: NTIS (US Sales Only) HC A03/MF A01; HMSO 30p;

Dielectronic recombination coefficients were computed for hydrogenic ions from He2 to Fe16 over a range of conditions typical of laser generated plasma. The results are displayed in a set of graphs together with the corresponding collisional radiative recombination coefficients. A comparison of these results indicates plasma conditions where dielectronic recombination is a significant process. ERA

N77-27969# General Atomic Co., San Diego, Calif.
METHOD OF CONTROLLING IMPURITY TRANSPORT
Keith H. Burrell and T. Ohkawa 24 Aug. 1976 15 p refs Presented at Intern. Symp. on Plasma Wall Interaction, Juelich, West Germany, 18 Oct. 1976
(Contract E(04-3)-0167)
(GA-A-14116; Conf-761049-4) Avail: NTIS HC A02/MF A01

A proposed method of impurity control, based on poloidally asymmetric injection of hydrogen gas into a Tokamak discharge is discussed. This injection creates a localized source of protons, which then interact with the impurities by Coulomb collisions. In a toroidal device, each species has a flow pattern such that there is an upward or downward drift (depending on the toroidal field polarity) which is compensated for by a return along the field lines. The motion of impurities is slower due to their higher

Z. Thus, collisional friction between species exists and can be shown to cause radial diffusion of impurities. The source of protons allows one to compensate the vertical drift, thus altering the collisional friction and the radial diffusion. Calculations show that the magnitude of the sources required can be attained in present machines. ERA

N77-27970# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.
THEORETICAL INVESTIGATIONS RELEVANT TO MAGNETIC FUSION ENERGY RESEARCH Progress Report, 31 Jan. 1976 - 1 Jan. 1977
T. Kammash 1 Jan. 1977 9 p refs
(Contract EY-76-S-02-1478)
(COO-1478-15) Avail: NTIS HC A02/MF A01

Kink modes arising from the coupling of the runway beam with the shear-Alfven waves in the plasma were studied. The radiation from these electrons was also studied. In the area of mirror physics, attention was focused on the derivation of the conductivity tensor for a weakly inhomogeneous plasma situated in a weakly inhomogeneous magnetic field with the objective of studying finite beta effects on microinstabilities. ERA

N77-27971# Addis Translations International, Portola Valley, Calif.
DELFIN HIGH-POWER LASER THERMONUCLEAR MACHINE
N. G. Basov, O. N. Krokhin, Yu. A. Mikhailov, G. V. Sklizkov, and S. I. Fedotov Dec. 1976 48 p refs Transl. into ENGLISH of "Moshcnaya Lazernaya Termoyadernaya Ustanovka Delfin", Preprint-151 Lebedev Phys. Inst., Acad. of Sci. USSR, Moscow, 1976 Prepared for California Univ., Livermore. Lawrence Livermore
(UCRL-Trans-11201; PREPRINT-151) Avail: NTIS HC A03/MF A01

The high-power 12-channel Del'fin laser device, designed for high-temperature heating of thermonuclear targets in a spherical irradiation geometry, is described. The device includes a neodymium laser with a maximum radiative energy of approximately 10 kJ, a light pulse lasting 10 to the -10th power to 10 to the -9th power sec with an irradiation divergence of approximately 0.0005 rad, a vacuum chamber in which the laser radiation interacts with a plasma, and a set of devices for laser parameter and plasma diagnostics. The optical design and structural characteristics of the laser system are discussed. Designs for focusing the radiation on a target are analyzed, and the focusing system of the Del'fin device, permitting a high degree of symmetry of the spherical irradiation of the target with a maximum flux density of approximately 10 to the 15th power/sq cm on its surface, is described. In the case of a laser system with a series-parallel arrangement of the amplification stages, relationships are obtained which make it possible to analyze the effect of the target and laser parameters on the magnitude of the maximum possible laser pulse energy in a spherical heating geometry. The results obtained were used in the design of the Del'fin high-power laser device. ERA

N77-27972# Parker (Lee W.), Inc., Concord, Mass.
THEORY OF ELECTRON EMISSION EFFECTS IN SYMMETRIC PROBE AND SPACECRAFT SHEATHS Final Report, 1 Nov. 1975 - 30 Jun. 1976
Lee W. Parker 30 Sep. 1976 75 p refs
(Contract F19628-76-C-0110)
(AD-A037538; AFGL-TR-76-0294) Avail: NTIS HC A04/MF A01 CSCL 20/9

A computer model developed earlier, for the rigorous theory of the steady-state sheath structure about and the particle fluxes to a conducting spherical body in a collisionless plasma, has been extended to include the contributions of emitted electrons in addition to those of the ambient plasma. The method is also extended to apply to long cylinders as well as to spheres. Potential barriers and general non-monotonic potential distributions are taken into account. Solutions are possible for wide ranges of the values of the relevant parameters, and are applicable to the sheaths and fluxes of emitting spacecraft, and to the current-voltage characteristics of emitting Langmuir probes. Solutions are presented for a number of sample problems, using a code PARKSS based on the analysis of this report. The discussion of these solutions includes comparisons with previous theories and experimental data. In these problems the effects are considered of variations of (a) surface potential, (b) monoenergetic versus Maxwellian emission velocity distributions, (c) emission flux relative to ambient fluxes (weak versus strong emission), and (d) emission temperature relative to ambient temperatures (cold versus warm emission), on potential barriers and net surface fluxes. GRA

N77-27973# California Univ., Los Angeles. Dept. of Physics.
GENERATION OF DENSITY CAVITIES AND LOCALIZED ELECTRIC FIELDS IN A NONUNIFORM PLASMA
G. J. Morales and Y. C. Lee Jan. 1977 60 p refs Submitted for publication
(Contract N00014-75-C-0476; NR Proj. 012-306)
(AD-A037524; PPG-292) Avail: NTIS HC A04/MF A01 CSCL 20/9

A simple model is presented which is capable of describing the detailed space-time evolution of the interaction of long wavelength electromagnetic radiation with an unmagnetized plasma having a nonuniform density profile. The model consists of describing the electric field via the nonlinear Schrodinger equation and the density changes through the ion-acoustic wave equation with the ponderomotive force effects included self-consistently. In the linear regime, this formulation explains the time evolution of the mode-conversion process that leads to the excitation of a short wavelength Langmuir wave in the neighborhood of the resonance layer where the frequency of the external radiation matches the local value of the electron plasma frequency. In the nonlinear regime, the model predicts the generation of density cavities and the associated spatial localization of the electric field. GRA

N77-27974# California Univ., Los Angeles. Dept. of Electrical Sciences and Engineering.
EXPERIMENTAL SIMULATION OF PARAMETRIC INSTABILITIES IN LASER-PLASMA INTERACTIONS Interim Report
N. C. Luhmann, Jr. Nov. 1976 44 p refs Presented at the US-Japan Seminar on Laser Interactions with Matter, New York, 2-5 Nov. 1976
(Contracts F49620-76-C-0012; E(04-3)-34; Grant NSF ENG-75-14452; AF Proj. 9751)
(AD-A037761; UCLA-ENG-7701; AFOSR-77-0157TR) Avail: NTIS HC A03/MF A01 CSCL 20/9

There is currently a great interest in the mechanisms by which intense electromagnetic radiation interacts with plasmas. A major impetus for this interest has been the laser-pellet fusion program. The process whereby the incident electromagnetic wave gives up energy to the plasma can be much more complex than simple binary collisional damping by electron-ion collisions. Author (GRA)

N77-27975# California Univ., Los Angeles. Dept. of Physics.
COUPLING OF LOWER-HYBRID RADIATION AT THE PLASMA EDGE
G. J. Morales Jan. 1977 58 p refs
(Contract N00014-75-C-0476; NR Proj. 012-306)
(AD-A037523; PPG-288) Avail: NTIS HC A04/MF A01 CSCL 20/9

This investigation considers the mode-conversion process encountered in the lower-hybrid heating scheme at the edge of the plasma, where the frequency of the external radiation is comparable to the local value of the electron plasma frequency. The problem is formulated in terms of a modulational representation of the electric field that permits the description of the full space-time evolution of the process. The numerical study of the model equations confirm that a backward wave is excited at the edge and that it leads to a net energy flow directed toward the interior of the plasma. For small external power levels, the flow is characterized by the propagation of a leading-edge pulse whose arrival at a given spatial location marks the onset of the steady-state. At large external power levels, the self-consistent modification of the density profile by the pondermotive force is found to quench the mode-conversion process, thus causing a significant reduction in the amount of RF energy that can be coupled from the external source to the interior of the plasma. Author (GRA)

N77-27976# Illinois Univ., Urbana-Champaign. Charged Particle Research Lab.
DESIGN AND CONSTRUCTION OF A DENSE PLASMA FOCUS DEVICE, PART 1 Final Report
David Lee Willenborg and Charles D. Hendricks Oct. 1976 97 p refs
(Grant AF-AFOSR-2643-74)
(AD-A037245; CPRL-2-76-Pt-1; UILU-ENG-76-2557-Pt-1; AFOSR-77-0134TR-Pt-1) Avail: NTIS HC A05/MF A01 CSCL 20/9

This paper deals with the design of a dense plasma focus device as an engineering project. Essentially this approach can be summarized as follows: First, an introduction dealing with a general discussion of plasma devices focusing on the role of a dense plasma focus device as a useful tool in future research; second, an explanation of the operation of the dense plasma focus; third, a general design discussion of the dense plasma focus device; fourth, specification of a realizable system; and finally, a discussion of the problems encountered in constructing this design and observations concerning the effectiveness of this dense plasma focus design. Author (GRA)

N77-27977# Illinois Univ., Urbana-Champaign. Charged Particle Research Lab.
X-RAY EMISSION FROM THE INTERACTION OF A MACROSCOPIC PARTICLE WITH A DENSE PLASMA FOCUS Final Report
Kam Fook Yeung and Charles D. Hendricks Oct. 1976 151 p refs
(Grant AF-AFOSR-2643-74)
(AD-A037354; CPRL-1-76; UILU-ENG-76-2556; AFOSR-77-0130TR) Avail: NTIS HC A08/MF A01 CSCL 20/9

Recently the interest in dense plasma focus has greatly increased because of the possibility of developing the device into an intense, pulsed radiation source of X-rays and neutrons for test purposes. Various experimenters have tried to scale up their radiation intensities by using large capacitor banks. Yet experimental results show that besides the engineering problems associated with the machine, as the bank voltage or capacitance goes up, the intensity cannot be scaled up indefinitely by increasing the bank energy. This work proposed a new, alternative way to enhance the X-ray radiation by using a macroscopic particle to interact with a plasma focus. A theoretical study was carried out to predict the relative amount of X-ray increase when a macroscopic particle was placed in the focus region. Two assumptions were made in this study: the particle essentially had the same physical dimensions throughout the lifetime of the focus because of enormous hydrodynamic pressure compressing any ablated neutral cloud onto the particle; and the electrons were thermalized to assume a Maxwellian distribution. Most of the X-ray radiation from a focus was due to the electron bombardment of the anode surface and was accounted for by the thick-target Bremsstrahlung theory. According to this theory, the X-ray emission was proportional to the first power of the atomic number, Z, of the target material, but not to the square of Z as in the thermal bremsstrahlung case. GRA

N77-27978# Naval Research Lab., Washington, D. C.
MAGNETIC-FIELD-INDUCED ENHANCEMENT OF RELATIVISTIC-ELECTRON-BEAM ENERGY DEPOSITION Interim Report
D. Mosher and I. B. Bernstein Feb. 1977 16 p refs Sponsored by DNA
(AD-A037693; NRL-MR-3441) Avail: NTIS HC A02/MF A01 CSCL 20/9

The collisional transport of relativistic electron beams in dense, magnetized, high-Z plasmas is characterized by a perturbation solution of the relativistic Boltzmann equation with a Fokker-Plank collision term in the limit of small beam-electron mean-free-path or gyroradius. The general formulation allows for arbitrary magnetic-field, electric-field, and plasma geometries. Analytic solutions in 1-D yield energy-deposition profiles for a magnetized plasma slab. Author (GRA)

N77-27979# Naval Research Lab., Washington, D. C. Plasma Dynamics Branch.
STABILITY OF TRAPPED ELECTRON MODES IN TOKAMAKS WITH ELONGATED CROSS SECTION Interim Report
Edward Ott (Cornell Univ., Ithaca, N. Y.), K. R. Chu (Science Applications, Inc., McLean, Va.), and Wallace M. Manheimer Feb. 1977 14 p refs Sponsored by ERDA
(AD-A037553; NRL-MR-3459) Avail: NTIS HC A02/MF A01 CSCL 20/9

The trapped electron mode can be substantially stabilized on flux surfaces which are sufficiently vertically elongated (especially in high temperature regimes). Author (GRA)

N77-27980# Polytechnic Inst. of New York, Brooklyn. Dept. of Electrical Engineering and Electrophysics.
AN EXPERIMENTAL AND THEORETICAL STUDY OF THE PROPAGATION OF HIGH AMPLITUDE PULSES IN A BOUNDED MAGNETO-PLASMA Interim Report
Erich E. Kunhardt and Bernard R-S. Cheo Jun. 1976 123 p refs
(Grant AF-AFOSR-2668-74)
(AD-A037663; POLY-EE/EP-76-011; AFOSR-77-0158TR) Avail: NTIS HC A06/MF A01 CSCL 20/9

Experiments on the propagation of narrow, high amplitude pulses along a plasma column have been conducted. The evolution of the pulse in space-time has been observed as a function of initial pulse strength. This technique gives insight into the competitive effects due to dispersion and nonlinearities. For a plasma, the positive column of a hot cathode, dc discharge in Argon is used. The pressure varied from 1 to 10m Torr Hg, and the averaged electron densities are of the order of 10 to the 9th power to 10 to the 10th power per. The pulses for excitation are generated by a home made device capable of producing subnanosecond pulses with 3,200 volts peak amplitude, into a 50 OHM line, at a repetitive rate of approximately 100 p.p.s. At each operating point, i.e., for a given pressure and discharge current, recordings were obtained for different values of excitation pulse amplitude and background static magnetic field. For zero static magnetic field, two types of recordings were taken. For the first type, the position of the receiver was fixed and oscillograms in time were recorded. In the second type, the sampling time is kept fixed and the receiving probe is moved along the column. GRA

N77-27981# University Coll., Cork (Ireland). Dept. of Electrical Engineering.
SUBMILLIMETRE LASER, MICROWAVE AND SPECTROSCOPIC DIAGNOSTIC OF IONIZATION IN GASEOUS PLASMAS Final Report, 1 Jun. 1972 - 30 Jun. 1976
Michael C. Sexton 31 Aug. 1976 17 p refs Sponsored in part by European Office of Sci. Res.
(Grant AF-AFOSR-2338-72)
(AD-A037965; AFOSR-77-0208TR) Avail: NTIS HC A02/MF A01 CSCL 20/9

Afterglow electron density decay mechanisms and energy losses in high energy argon and helium plasmas including measurements of ion conversion rates were carried out. A computational study of the hydrogen and helium afterglows was also completed. Development of a HCN submillimeter laser included work on the significance of mode compression near the critical density. Microwave electron temperature measurements in a current modulated plasma column were also undertaken. Author (GRA)

N77-27982# Universal Energy Systems, Inc., Dayton, Ohio.
ANALYSIS OF COMBUSTION PLASMAS BY FOURIER SPECTROSCOPY Final Report, 1 Jun. - 30 Sep. 1976
Charles A. DeJoseph, Jr. and Max Lake 15 Dec. 1976 88 p refs
(Contract F44620-76-C-0102; AF Proj. 9751)
(AD-A037217; AFOSR-77-0131TR) Avail: NTIS HC A05/MF A01 CSCL 20/9

Fourier transform spectroscopy has been used to study the infrared emission from a premixed, methane air flame using a flat flame burner, in the region 1700/cm to 7000/cm. Some preliminary data were also obtained in the region from 400/cm to 1700/cm. All spectra were taken with 1/cm resolution or better. Spectra were obtained at various heights above the burner base and under a variety of mix ratios. From the rotational

structure in the CO fundamental band, rotational and vibrational temperatures were obtained for a rich fuel mix. Author (GRA)

N77-27983# Avco-Everett Research Lab., Everett, Mass.
HIGH POWER DENSITY MHD GENERATORS Final Technical Report
Robert Kessler Wright-Patterson AFB, Ohio AFAPL Mar. 1976 60 p refs
(Contract F33615-75-C-2047; AF Proj. 3145)
(AD-A038612; AFAPL-TR-76-71) Avail: NTIS HC A04/MF A01 CSCL 20I

Operating parameters were calculated for MHD generators operating at power densities in the channel of 500 MW/cu m and with power outputs of 30 - 35 MW (nominal). Liquid-fueled generators, using hydrocarbon fuels such as JP-4 or RP-1 and oxygen, and solid fuel generators were investigated. Designs of both liquid and solid fuel generators are described, and estimates of their weights and sizes are given. Operation of generators at power densities of 1000 MW/cu m was investigated. Assessments of feasibility and risks involved in achieving high power density operation are made. A development plan for construction of flightweight high power density MHD generator power supplies is presented. Author (GRA)

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

N77-27984 Texas Univ., Austin.
ENERGY BANDS AND ELECTRONIC STRUCTURE OF FERROMAGNETIC IRON THIN FILMS Ph.D. Thesis
Don George Dempsey 1976 151 p
Avail: Univ. Microfilms Order No. 77-3890

Tight-binding calculations of the electron energy bands of (100), (110), and (111) ferromagnetic iron thin films were performed. The Hamiltonian matrix elements were derived from a bulk calculation of Tawil and Callaway using the Slater and Koster parameterization scheme. These parameters were then used to calculate the thin film energy bands for each spin at numerous points in the two dimensional Brillioun zones. The diagonal matrix elements on the surface layers were shifted to obtain surface charge neutrality. Planar and total densities of states are calculated. Dissert. Abstr.

N77-27985 Indiana Univ., Bloomington.
AN EXPERIMENTAL INVESTIGATION OF CONDITION ELECTRON SPIN DENSITY OSCILLATIONS IN DILUTE ALLOYS OF MANGANESE IN SILVER Ph.D. Thesis
Theodore Donald Finsod 1976 153 p
Avail: Univ. Microfilms Order No. 77-1888

A variant of the experimental technique of double nuclear magnetic resonance (DNMR) is used to investigate the response of the host conduction electrons to the localized magnetic moments of manganese ion solutes dissolved in a pure silver host metal at dilutions below 100 ppm, and at a temperature of 1.2 K. The coupling of the manganese ion magnetic moment to the conduction electrons, via an exchange interaction produces RKKY oscillations in the conduction electron spin density polarization. The magnitude of the RKKY oscillations deduced from this experiment disagreed with the magnitude predicted theoretically when the generally accepted value of J(0) = 1.0eV for the exchange coupling constant was used. The magnitude is consistent, however, with that necessary to explain the line broadening effects in the standard NMR absorption spectra of dilute AgMn alloys run by Snodgrass. Dissert. Abstr.

N77-27986 Purdue Univ., Lafayette, Ind.
LATTICE DYNAMICS OF CRYSTALS. 1: BRILLOUIN SCATTERING IN CRYSTALS. 2: EFFECT OF THE ISOTOPIC CONSTITUTION ON THE LATTICE PARAMETER Ph.D. Thesis
Marcos Hugo Grimsditch 1976 183 p
Avail: Univ. Microfilms Order No. 77-1721

Brillouin scattering in diamond, rutile, and silver thiogallate is studied with a triple passed scanning Fabry-Perot interferometer. By observing the spectra with large order differences between a Brillouin component and its parent laser line the room temperature elastic moduli are obtained with high accuracy. Dissert. Abstr.

N77-27987 Indiana Univ., Bloomington.
ULTRASONIC STUDIES OF MAGNET-FIELD DEPENDENT INTERACTIONS IN METAL Ph.D. Thesis
Rajender Gujral 1976 99 p
Avail: Univ. Microfilms Order No. 77-1896

A very sensitive new spectrometer, the double-pulse-comparison spectrometer, was developed for measuring very small changes in ultrasonic velocity. Velocity changes of less than one part in 10 to the nineth power have been observed. It is suggested that the double-pulse-comparison technique should be useful in carrying out ultrasonic studies of Fermi surfaces, superconducting phase transitions and may be used to study diffusion mechanisms in metals. Using the above technique, out precision measurements of the ultrasonic velocity shift were carried as a function of magnetic field in single crystals of pure copper and vanadium. In the temperature and field range studied, the dominant interaction is expected to be the nonresonant Alpher-Rubin interaction, which involves a coupling of the ultrasonic waves to the conduction electrons in metals. The measurements on copper were made to test the double-pulse-comparison technique and the method of data analysis. Dissert. Abstr.

N77-27988 California Univ., Los Angeles.
SOLITONS AND THE STRUCTURE OF SHOCK WAVES IN ONE-DIMENSIONAL NON-LINEAR LATTICES Ph.D. Thesis
Thomas Guy Hill 1976 399 p
Avail: Univ. Microfilms Order No. 77-1636

Numerical shock experiments are performed in the one lattice (Toda's exponential lattice) for which analytic expressions for the solitons are known. The peak particle velocity at the shock front is found to asymptotically approach twice the mean particle velocity in the shock tail. A stable region of non-zero lattice vibration is found to form in the shock tail. The vibrations are accurately represented by a soliton wave train of wave length two. The experimental shock velocity is found to be inconsistent with the Rankine-Hugoniot conservation equations. The experimental shock velocity can be accurately predicted from the notion that the front of the shock is led by a soliton whose peak particle velocity is equal to twice the mean particle velocity in the shock tail. Soliton solutions are found in a harmonic lattice with hard spheres and in lattices with an arbitrary differential potential. Dissert. Abstr.

N77-27989 Kansas Univ., Lawrence.
PAIR CORRELATION MODEL FOR SUPERFLUID HELIUM-4 Ph.D. Thesis
Lin-ing Kung 1976 146 p
Avail: Univ. Microfilms Order No. 77-2246

The qualitative and quantitative behavior of the pair Hamiltonian Hp which is extracted from the hardcore model with a square well attractive tail for liquid helium-4 is examined. Although the qualitative features do have some resemblances to the experimental results, there are no quantitative agreements. It is found that at certain liquid densities, the pair Hamiltonian alone gives a convergent numerical result indicating zero amount of B-E condensation, in agreement with the experimental and theoretical estimations and a ODLRO due to opposite momenta pairs. It is concluded that a more realistic model for liquid helium 2 can be formulated by including H sub r and by using N sub O/N as a smallness expansion parameter. Dissert. Abstr.

N77-27990 Pittsburgh Univ., Pa.
MAGNETIC FIELD DEPENDENCE OF THE MICROWAVE SURFACE IMPEDANCE OF DILUTE ALUMINUM ALLOYS Ph.D. Thesis
Frederick Heiskell Rogan 1976 84 p
Avail: Univ. Microfilms Order No. 77-3032

The effect of impurities on the microwave absorption of superconducting aluminum in a static magnetic field was determined for samples containing 0.02 At.% or 0.13 At.% germanium, for one sample containing 5.0 At.% zinc, and for one sample containing approximately 1.0 At.% silver. The samples were examined by both optical and electron microscopy and by

electron probe microanalysis, supplemented by measurements of residual resistivity, superconducting transition temperature, and critical magnetic field, and are considered well characterized. The resonant peaks in absorption at the superconducting energy gap are shown to be substantially independent of sample microstructure or of chemical species of impurity. Dissert. Abstr.

N77-27991 Indiana Univ., Bloomington.
GENERATION AND DETECTION OF HIGH-ENERGY PHONONS BY SUPERCONDUCTING JUNCTIONS Ph.D. Thesis
Irwin Lee Singer 1976 193 p
Avail: Univ. Microfilms Order No. 77-936

Superconducting tunnel junctions are used to investigate the dynamics of energy exchange that takes place in superconductors driven out of equilibrium. In a Sn junction the tunneling current sustains a continual energy exchange among the quasiparticles, phonons, and Cooper pairs. Repeatedly, high-energy quasiparticles decay, emitting phonons; and phonons with energy greater than 2 delta (Sn) break pairs, producing quasiparticles. The principal probe of the particle dynamics is those phonons of energy greater than 2 delta (Sn) which escape the Sn junction. Contrary to the earlier negative results of others, such phonons do escape, and in sufficient number to be detected by a pb junction detector. Upon arrival at the detector, these phonons are absorbed by pair breaking, which gives rise to high-energy excitations. The quasiparticle excitations become part of the tunneling current flowing across the junction. Dissert. Abstr.

N77-27992 California Inst. of Tech., Pasadena.
RADIO FREQUENCY STUDIES OF SURFACE RESISTANCE AND CRITICAL MAGNETIC FIELD OF TYPE 1 AND TYPE 2 SUPERCONDUCTORS Ph.D. Thesis
Tadashi Yogi 1977 163 p
Avail: Univ. Microfilms Order No. 77-3139

The surface resistance and the critical magnetic field of lead electroplated on copper were studied at 205 MHz in a half wave coaxial resonator. The rf critical magnetic field was also studied at 90 MHz for pure tin and indium, and for a series of SnIn and InBi alloys spanning both type I and type II superconductivity. The samples were spherical with typical diameters of 1-2 mm and a helical resonator was used to generate the rf magnetic field. Dissert. Abstr.

N77-27993# California Univ., Berkeley. Lawrence Berkeley Lab.
DIVACANCY-HYDROGEN COMPLEXES IN DISLOCATION-FREE HIGH-PURITY GERMANIUM
E. E. Haller, G. S. Hubbard, W. L. Hansen, and A. Seeger (Max-Planck-Institute fuer Metallforschung) Sep. 1976 22 p refs Presented at Intern. Conf. on Radiation Effects in Semicond., Dubrovnik, Yugoslavia, 6 Sep. 1976
(Contract W-7405-eng-48)
(LBL-4274) Avail: NTIS HC A02/MF A01

A defect center with a single acceptor level at E/Sub v/ + 0.08 eV appears in H2-grown dislocation-free high-purity germanium. Its concentration changes reversibly upon annealing up to 650 K. By means of Hall-effect and conductivity measurements over a large temperature range the temperature dependence of the steady-state concentration between 450 and 720 K as well as the transients following changes in temperature were determined. The observed acceptor level is attributed to the divacancy-hydrogen complex V2H. The complex reacts with hydrogen, dissolved in the Ge lattice or stored in traps, according to V2H + H reversible V2H2. An energy level associated with the divacancy-dihydrogen complex was not observed. These results are in good agreement with the idea that hydrogen in germanium forms a 'very deep donor (i.e., the energy level lies inside the valence band). ERA

N77-27994# Minnesota Univ., Minneapolis. School of Physics.
EXPERIMENTAL STUDIES IN SOLID STATE AND LOW TEMPERATURE PHYSICS Progress Report, 1976
A. M. Goldman, W. V. Weyhmann, and W. Zimmermann, Jr. Sep. 1976 34 p refs
(Contract EY-76-S-02-1569)
(TID-27221; E-1569-138) Avail: NTIS HC A03/MF A01

Results of investigations in superconductivity, magnetism in metals, and liquid and solid helium are presented. Topics examined include: (1) the pair-field susceptability of superconductors; (2) a propagating mode in the phase of the superconducting order parameter; (3) heat capacities of superconducting films in the vicinity of T sub c; (4) the properties of thin film solid solutions of sodium in ammonia; (5) the dilute magnetic impurity problem in metals in the 1 mK temperature region; (6) the quantization of circulation in superfluid liquid He-4; and (7) the dynamics of superfluid flow through submicron pores. ERA

N77-27995# Los Alamos Scientific Lab., N. Mex.
OBSERVATION OF COHERENT RESONANCE FLUORESCENCE IN HOT CO2
S. J. Czuchlewski, B. J. Feldman, Robert A. Fisher, and A. Nowak 1976 12 p refs Presented at the Am. Phys. Soc. Meeting, Stanford, Calif., 20 Dec. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2301; Conf-761204-1) Avail: NTIS HC A02/MF A01

Hot CO2 was used to check theoretical understanding by using one nanosecond pulses. The results are in relatively good agreement with theory. The experimental setup consisted of a one nanosecond duration 1/2 millijoule switched-out pulse directed through two heated pyrex cells filled with CO2 and filled with NaCl windows at Brewster's angle. The cells were 190 cm long of which 160 cm were heated to 300 + or - 10 C for a total heated path of 320 cm. Results are shown. They verify previous knowledge that hot CO2 operating as a linear filter is not for one nanosecond systems, i.e., good baseline rejection and lack of ringing are incompatible for one nanosecond pulse durations. Some preliminary data are given on an attempt to compress a one nanosecond switched-out pulse by a factor of 6 by saturating SF6 in a short cell. ERA

N77-27996# Los Alamos Scientific Lab., N. Mex.
APPLICATIONS OF SUPERCONDUCTIVITY IN ELECTRIC POWER SYSTEMS
William E. Keller 1976 20 p refs Presented at the Frontiers of Power Technol. Conf., Stillwater, Okla., 27 Oct. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1998; Conf-761030) Avail: NTIS HC A02/MF A01

Major applications of superconductivity to power systems are considered. The state of the art of materials and refrigeration developments that are necessary for these applications is reviewed. Specific applications including superconducting cables for power transmission and superconducting magnetics for MHD generators, for energy storage, and for magnetically confined fusion power generation are discussed in terms of their advantages and the progress being made toward introducing the various devices into real situations. It is concluded that the feasibility of superconducting devices is assured, and that, although their performance, reliability, and cost effectiveness for use in power generation, transmission, and storage remain to be proven, it is reasonable to expect that superconductivity can make it in the real world. ERA

N77-27997# Illinois Univ., Urbana. Dept. of Chemistry.
CHARACTERIZATION OF THE 2p X-RAY PHOTOELECTRON SPECTRA OF FIRST ROW TRANSITION METAL ELEMENT COMPOUNDS Ph.D. Thesis
Gregory Allen Vernon 1976 90 p refs
(Contract E(40-1)-GEN-33; Grant NSF DMR-72-03026)
(TID-27271) Avail: NTIS HC A05/MF A01

The X-ray photoelectron spectra of the 2p shell of transition metal halides, pseudohalides, cyanides, and other complexes are studied. The data, together with literature data, are compiled to give an overall view of the phenomenon of satellite structure. Effects of varying the ligand, central metal atom, and charge on the central metal atom are analyzed. The data are explained on the basis of a charge transfer model where a ligand sigma(e/sub g/) electron is transferred into a metal 3d(e/sub g/) orbital. This corresponds to a sigma(e/sub g/) yields sigma*(e/sub g/) or 2e/sub g/ yields 3e/sub g/ transition in molecular orbital terminology. Intensities of the satellites were found to be dependent upon the type of ligand and the energy spacing between the two e/sub g/ sets. Some spectral data from compounds of

second and third row transition metal elements and lanthanides are included. ERA

N77-27998# Oak Ridge National Lab., Tenn.
THERMAL AND FISSION NEUTRON-PRODUCED DEFECT CONFIGURATIONS IN PLATINUM
R. R. Coltman, Jr., C. E. Klabunde, and J. K. Redman 1976 9 p refs Presented at Intern. Conf. on Properties on Atomic Defects on Metals, Argonne, Ill., 18 Oct. 1976
(Contract W-7405-eng-26)
(CONF-761027-6) Avail: NTIS HC A02/MF A01

A procedure employing resistivity measurements was used to observe the production of free interstitials and vacancies in platinum by atomic recoils produced from thermal neutron capture and fission-neutron collision. For thermal neutrons, which produce damage much like fast electrons, free defect production increased nearly a factor of two with increasing irradiation temperature from 30 to 280 K. This is attributed to the increasing thermal dissociation of correlated pairs into free defects. Although the correlated pair population is less in similar recovery studies of the high-energy atomic recoils associated with fission neutron damage, one would expect to observe the effects of thermal dissociation, or in other terms, the temperature dependence of the I-V recombination volume. In contrast to the thermal neutron case, virtually no temperature dependence of free defect production was found for fission neutron damage produced over the same temperature range. ERA

N77-27999# Oak Ridge National Lab., Tenn.
DAMAGE RATES OF MeV Al IONS IN ALUMINUM
T. S. Noggle, B. R. Appleton, J. M. Williams, O. S. Oen, J. A. Biggerstaff, and T. Iwata (Japan Atomic Energy Res. Inst., Tokai-Mura) Nov. 1976 8 p refs Presented at 4th Ann. Conf. on Use of Small Accelerators, Denton, Tex., 25 Oct. 1976
(Contract W-7405-eng-26)
(CONF-761059-9) Avail: NTIS HC A02/MF A01

Damage rates of 5MeV(27)Al ions in Al were measured as a function of the ion path length in Al. The technique developed for this study employed evaporated Al thin film electrical resistivity specimens, as a damage sensor, and variation in ion path lengths were obtained by insertion of thin foils of Al immediately in front of the resistivity specimen. Irradiations and electrical resistance measurements were carried out below 10 K to 'freeze in' the displacement damage and to provide suitable conditions for precision electrical measurements. The resistance increase due to irradiation is a measure of the displacement damage resulting from ion-atom collisions in the specimen. The damage rates vary about an order of magnitude over the range of the ions and are in general agreement with calculated damage rates obtained from theory. ERA

N77-28000# Berkeley Scientific Translation Service, Calif.
EFFECT OF QUENCHING FROM THE LIQUID STATE ON THE SUPERCONDUCTING PROPERTIES AND STRUCTURE OF THE ALLOYS Nb-Ga AND Nb3(Ge,Al)
Yu. F. Bychkov, V. S. Kruglov, B. T. Sizov, and E. I. Yakoulev 1974 9 p refs Transl. into ENGLISH from the book "Struktura i Svoistva Sverkhprovodyaschikh Materialov" Moscow, Izd. Nauka, 1974 p 14-19 Text in ENGLISH and RUSSIAN Prepared for Lawrence Berkeley Lab. Sponsored by ERDA
(UCRL-Trans-1532) Avail: NTIS HC A02/MF A01

Quenching from the liquid phase was used to obtain alloys in metastable states. Alloys of the Nb-Ga and Nb3(Ge,Al) systems in a broad range of concentrations were quenched at cooling rates up to 1,000,000 deg/sec. For low cooling rates, when the grain size after quenching is 15 to 20 microns, the alloys have a sharp superconducting transition. The results obtained indicate that quenching from the liquid phase is a powerful technique that alters the structure of alloys and consequently the superconducting transition temperature. ERA

N77-28001# Berkeley Scientific Translation Service, Calif.
METHODS OF PREPARING FLEXIBLE SUPERCONDUCTORS BASED ON A15 SUPERCONDUCTING COMPOUNDS
E. M. Savitskii, Yu. V. Efimov, and O. I. Zvolinskii Oct. 1976 15 p refs Transl. into ENGLISH from the book "Struktura i Svoistva Sverkhprovodyaschchikh Materialov" Moscow, Izd. Nauk, 1974 p 7-14 Text in ENGLISH and RUSSIAN Sponsored by ERDA Prepared for Lawrence Berkeley Lab.
(UCRL-Trans-1531) Avail: NTIS HC A02/MF A01

Current methods of producing A15 compounds are reviewed. It is concluded that the highest technological effectiveness is observed in the solid-state diffusion technique which makes it possible to obtain a material with high superconducting properties with adequate plastic characteristics. ERA

N77-28002# Brookhaven National Lab., Upton, N. Y.
APPROXIMATE METHOD FOR CALCULATING THE LIFETIME OF POSITRONS TRAPPED BY LATTICE DEFECTS
D. O. Welch and K. G. Lynn 1976 8 p refs Presented at Intern. Conf. on the Properties of Atomic Defects in Metals, Argonne, Ill., 18-22 Oct. 1976
(Contract EY-76-C-02-0016)
(BNL-21937; Conf-761027-4) Avail: NTIS HC A02/MF A01

A method which takes account of core as well as valence electrons is presented for theoretically estimating the lifetime of positrons trapped in lattice defects. Calculations for vacancies and divacancies in aluminum are given. ERA

N77-28003# Berkeley Scientific Translation Service, Calif.
STRUCTURE AND SUPERCONDUCTING PROPERTIES OF TERNARY ALLOYS BASED ON METALLIC COMPOUNDS
E. M. Savitskii, V. V. Baron, Yu. V. Efimov, M. I. Bychkova, L. F. Myzenkova, and V. N. Sumarokov Oct. 1976 12 p refs Transl. into ENGLISH from Struktura i Svoistva Sverkhprovodyashchikh Mater. Izdatel'stvo Nauka (Moscow), 1974 p 77-84 Sponsored by ERDA Prepared for Calif. Univ., Berkeley. Lawrence Berkeley Lab.
(UCRL-Trans-1538) Avail: NTIS HC A02/MF A01

An investigation was undertaken of the change in T/sub c/ in different phase regions of ternary alloys based on the A15 structure: Nb3Ga-Nb3Ge, Nb3Sn-Sm, Nb-Zr-Sn, V3Si-Mn3Si, and V3Si-V3 Ga. Results show that the T/sub c/ change obeys the fundamental laws of physiochemical analysis: T/sub c/ changes continuously with composition in ternary solid solutions, has a singular maximum upon the formation of a superconducting ternary compound, is constant for superconducting phases in the three-phase region, and changes in two-phase regions. ERA

N77-28004# Argonne National Lab., Ill.
HARDENING, RECOVERY, AND CREEP IN fcc MONO- AND POLYCRYSTALS
H. Mecking, U. F. Kocks, and H. Fischer 1976 7 p refs Presented at the 4th Intern. Conf. on Strength of Metals and Alloys, Nancy, 30 Aug. - 3 Sep. 1976
(Contract W-31-109-eng-38)
(CONF-760804-3) Avail: NTIS HC A02/MF A01

The Bailey-Orowan approach to simultaneous strain hardening and recovery is shown to be in conflict with experimental results on the work-hardening behavior of many fcc mono- and polycrystals, and therefore should not be used in creep theories either. A more promising approach is the superposition of strain hardening and strain softening, a term used for mechanically rather than thermally activated recovery processes. The strain rate dependence of the mechanical properties is then characterized by two exponents m and n, one for the isostructural flow stress and one for the strain-softening process. The latter dominates steady state creep up to temperatures of about 0.6 of the melting point, and can, by extrapolation, even explain high-temperature creep. ERA

N77-28005# Westinghouse Defense and Electronic Systems Center, Baltimore, Md. Systems Development Div.
MNOS BORAM MANUFACTURING METHODS AND TECHNOLOGY PROJECT Quarterly Progress Report, 1 Jul. - 30 Sep. 1976
J. E. Brewer, T. G. ODonnell, P. C. Smith, and L. A. Epstein Sep. 1976 85 p refs
(Contract DAAB07-76-C-0048)
(AD-A037444; Rept-76-1139; QPR-1) Avail: NTIS HC A05/MF A01 CSCL 09/5

A manufacturing methods project has been initiated to establish a pilot production line for metal nitride oxide semiconduc-

tors (MNOS) block oriented random access memory (BORAM) multichip hybrid circuits. The first phase of activity is concerned with definition and establishment of the required production capability. This report describes the chip fabrication sequence, and outlines some experimental investigations. Program status and plans for the next quarter are reviewed. Author (GRA)

N77-28006# Ballistic Research Labs., Aberdeen Proving Ground, Md.

ELECTRONIC EXCITATION IN NO AND SN BY THE NON-MUFFIN-TIN X-ALPHA METHOD

Douglas A. Ringers Mar. 1977 20 p refs

(AD-A037802; BRL-1968) Avail: NTIS HC A02/MF A01 CSCL 20/8

Theoretical investigations of the electronic structure of SN, of interest because of the explosive nature of (SN)x, and its oxygen analogue NO, itself an important reaction product, have been performed by the x-alpha method using a perturbation technique to account for non-muffin-tin components of the charge density. The results, which differ from previous x-alpha calculations using overlapping sphere approximations to the charge density, are in good agreement with experimental values. Author (GRA)

N77-28007# National Bureau of Standards, Boulder, Colo. Cryogenics Div.

ELECTROCALORIC REFRIGERATION FOR SUPERCONDUCTORS Final Report, May 1973 - Jun. 1975

R. Radebaugh, J. D. Siegwarth, W. N. Lawless, and A. J. Morrow Feb. 1977 193 p refs

(Contract NAonr-1-75; ARPA Order 2535)

(AD-A037413; NBSIR-76-847) Avail: NTIS HC A09/MF A01 CSCL 20/3

A solid state type of refrigeration, which utilizes the electrocaloric effect in certain dielectric materials, has been investigated. Such a refrigerator would operate with a load at 4 K and reject heat to a reservoir at 15 K. Heat switches for such a refrigerator were studied. One type was a multiple leaf contract switch. The other type was a magnetothermal switch utilizing single crystal beryllium. Based upon earlier preliminary work, the refrigeration material was to be a SrTiO3 glass-ceramic. It was found here that such a material has no useful electrocaloric effect at 4 K. Many other materials were studied but none were found with sufficiently high electrocaloric effects for a practical refrigerator. The largest effects were seen in SrTiO3 ceramics, followed by KTaO3 single crystal. Temperature reductions of about 0.5 K at 10 K were observed during depolarization. A theoretical model, based on the electret behavior of impurity-vacancy dipoles, was developed to explain the observed dielectric behavior in the materials investigated. Another theoretical model, based on the lattice dynamics of displacive dielectrics, was used to explain the observed entropy and temperature changes seen in such materials. The model points out that displacive type materials have too low entropies at 4 K for practical refrigeration. An investigation of certain order-disorder dielectrics is suggested. Author (GRA)

N77-28008# Brown Univ., Providence, R. I. Dept. of Chemistry.

FAR INFRARED STUDY OF CATION MOTION IN DRY AND SOLVATED MONO- AND DIVALENT ZEOLITES X AND Y

Wayne M. Butler, Charles L. Angell (Union Carbide Corp., Tarrytown, N. Y.), Warren McAllister (East Carolina Univ.), and William M. Risen, Jr. 10 Mar. 1977 49 p refs Submitted for publication

(Contract N00014-75-C-0883)

(AD-A038665; TR-77-02) Avail: NTIS HC A03/MF A01 CSCL 07/4

Far infrared ion motion bands have been observed and assigned in the spectra of dry synthetic zeolites X and Y containing Li-, Na-, K-, Rb-, Cs-, Ag-, Ca2-, Sr2-, and Ba2- cations. The site I: and site II cation vibrational bands overlap and form the strongest feature in the spectra of samples exchanged with monovalent ions. The site I cation band appears at lower frequency than the site II envelope in these samples, but in divalent ion exchanged zeolites the opposite order occurs. A very low frequency site III cation band, typical of monovalent X zeolites, has been observed in CsY. For a given cation, the frequency on X is higher than on Y due to the higher framework charge of X zeolites. The vibrational frequencies also follow an approximate m raised to minus 1/2 power dependence for the two types of cation and the two forms of the zeolite. Solvation of the monovalent zeolites with H2O, THF, DMSO, pyridine, and CH2Cl2 results in the appearance of a new band at higher frequency than the ion-framework modes which concurrently diminish in intensity, especially the site III band. The high frequency band is due to ion motion in a solvation shell which is unsymmetric at low hydration levels and at all solvation levels with organic adsorbates. GRA

N77-28009# Maryland Univ., College Park.

ELASTIC AND INELASTIC CONTRIBUTIONS TO THE AUGER ELECTRON APPEARANCE POTENTIAL SPECTRUM OF TITANIUM

Marten DenBoer, Philip I. Cohen, and Robert L. Park 28 Mar. 1977 25 p refs Submitted for publication

(Contract N00014-75-C-0292)

(AD-A038680) Avail: NTIS HC A02/MF A01 CSCL 20/8

The energy distribution of electrons contributing to the L-shell Auger electron appearance potential spectrum of a polycrystalline titanium surface has been measured. The Auger electron appearance potential spectrum is obtained by differentiating the total secondary electron yield of an electron bombarded sample as a function of incident electron energy. At the threshold for scattering from a core level the secondary yield increases. Most of the electrons contributing to this increase have energies below 30 eV, and result from secondary processes following Auger recombination of the core hole. The elastic yield decreases at the threshold, however, due to opening a new channel for inelastic scattering. A comparison of the elastic yield spectrum (DAPS), the total yield spectrum (AEAPS) and the soft X-ray yield spectrum (SXAPS), shows very similar line shapes, but differences in the relative strength of the lines. Author (GRA)

N77-28010# Rutgers - The State Univ., New Brunswick, N. J.

HIGH FIELD CONDUCTION AND SWITCHING PHENOMENA AND MAGNETIC SPIN RESONANCE IN METAL OXIDE THIN FILMS AND SURFACES Final Technical Report, 31 Oct. 1976

Bogoljub Lalevic Feb. 1977 15 p

(Contract N00014-76-C-0091)

(AD-A038170) Avail: NTIS HC A02/MF A01 CSCL 09/1

Investigation was performed on transport, dielectric, switching and optical properties of thin amorphous and polycrystalline films of a series of transition metal and other oxides films. The conduction and dielectric dispersion mechanisms were unambiguously identified for each oxide studied in the parent metal-oxide-parent metal configuration. The switching phenomena and the observed RF oscillations in the negative resistance region were fully explained by the double injection model. Stable and reproducible switching devices were fabricated and the properties of important switching parameters studied as a function of composition temperature and applied voltage. Author (GRA)

N77-28011# City Coll. of the City Univ. of New York. Dept. of Physics.

LIGHT SCATTERING IN CRYSTALS WITH SURFACE CORRECTIONS

Melvin Lax and Donald F. Nelson Dec. 1976 15 p refs

(Grant DAAG29-76-G-0055)

(AD-A038403; ARO-13410.7-P) Avail: NTIS HC A02/MF A01 CSCL 20/6

A summary is given of techniques and results for calculating light scattering in anisotropic crystals valid for arbitrary directions of the incident beam, the scattered beam and the crystal surface normal relative to the crystal axes. A dyadic Green's function that distinguishes ray and propagation directions leads to a scattering efficiency inside the crystal that involves the Gaussian curvature of the surface of wave normals. After taking account of the solid angle expansion and the source volume demagnification at the crystal surface, a scattering formula is given suitable for comparison with experiments done outside the crystal. Author (GRA)

N77-28012# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

MEASUREMENTS OF AC LOSSES IN SUPERCONDUCTORS BELOW HC1.09 Final Report, Jan. 1974 - Jun. 1976
J. Thomas Broach Sep. 1976 50 p
(AD-A038393; MERADCOM-2191) Avail: NTIS HC A03/MF A01 CSCL 20/3

An ac bridge technique is described for measuring energy losses in multifilament (MF) superconductors due to alternating current flow in superconducting solenoids. Superconductivity and transient loss theory are briefly discussed, and the apparatus used to measure the losses is described in detail. Loss data as a function of frequency in the field region H H sub c1 were obtained from measurements on a number of solenoids which were wound from commercially available MF NbTi conductors. Some data is presented in which an external field of H H sub C1 is applied. Author (GRA)

N77-28013# City Coll. of the City Univ. of New York. Dept. of Physics.
LIGHT SCATTERING IN CRYSTALS WITH SURFACE CORRECTIONS
Melvin Lax and Donald F. Nelson (Bell Labs., Murray Hill, N.J.) Dec. 1976 18 p refs
(Contract N00014-76-C-0099; NR Proj. 395-003)
(AD-A038787; TR-27) Avail: NTIS HC A02/MF A01 CSCL 20/2

A summary is given of techniques and results for calculating light scattering in anisotropic crystals valid for arbitrary directions of the incident beam, the scatter beam and the crystal surface normal relative to the crystal axes. A dyadic Green's function that distinguishes ray and propagation directions leads to a scattering efficiency inside the crystal that involves the Gaussian curvature of the surface of wave normals. After taking account of the solid angle expansion, and the source volume demagnification at the crystal surface a scattering formula is given suitable for comparison with the experiments done outside the crystal. Application is made to Brillouin and Raman scattering.
Author (GRA)

N77-28014# Air Force Weapons Lab., Kirtland AFB, N.Mex.
A STUDY OF SILICON OXIDE GROWTH MECHANISMS FOR THE PURPOSE OF IDENTIFYING HARDNESS ASSURANCE TOTAL DOSE SCREENS Final Report
R. J. Maier Feb. 1977 41 p refs
(AD-A038639; AFWL-TR-76-228) Avail: NTIS HC A03/MF A01 CSCL 20/2

Processes exist today which will produce oxide layers on silicon semiconductor devices with total ionizing surface effects sufficiently suppressed to satisfy military needs. There remains the problem of assuring that the devices produced by these processes on a production line are indeed hard to surface effects, i.e., an unintended variation in processing has not reduced hardness. Some sort of acceptance test, called a hardness assurance screen, is needed. To identify possibilities for these tests, the literature was searched, analyses were performed, and special wooden ball molecular models were studied. The current model of oxide layer growth and the relations of such growth to total dose susceptibility were gleaned from the literature. This model was extended by the study as follows: Qss is caused by an oxygen atom which is bonded to three interface silicon atoms. This produces an interface donor state whose energy is above the silicon conduction band. Nss is primarily caused by a Si-O-Si bond in which the oxygen has been removed leaving a stretched Si-Si bond. This produces two interface states; a donor level near the valence band and an acceptor level near the conduction band. GRA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N77-28015*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GASPLOT - A COMPUTER GRAPHICS PROGRAM THAT DRAWS A VARIETY OF THERMOPHYSICAL PROPERTY CHARTS
Roger J. Trivisonno and Robert C. Hendricks Washington, D. C. Jun. 1977 58 p refs
(NASA-TN-D-8507; E-8627) Avail: NTIS HC A04/MF A01 CSCL 20M

A FORTRAN V computer program, written for the UNIVAC 1100 series, is used to draw a variety of precision thermophysical property charts on the Calcomp plotter. In addition to the program (GASPLOT), which requires (15 160) sub 10 storages, a thermophysical properties routine needed to produce plots. The program is designed so that any two of the state variables, the derived variables, or the transport variables may be plotted as the ordinate - abscissa pair with as many as five parametric variables. The parameters may be temperature, pressure, density, enthalpy, and entropy. Each parameter may have as many a 49 values, and the range of the variables is limited only by the thermophysical properties routine. Author

N77-28016# Texas Univ., Austin. Center for Particle Theory.
UNIVERSAL TIME VERSUS RELATIVISTIC TIME IN FOUR-DIMENSIONAL SYMMETRY FRAMEWORK
C. B. Chiu, J. P. Hsu, and T. N. Sherry Dec. 1976 31 p refs
(ORO-3992-292) Avail: NTIS HC A03/MF A01

A four-dimensional symmetry framework with a universal time is investigated which can be realized by a radioactive clock - the measured survival fraction of unstable particles gives the elapsed time. The world picture turns out to be quite different from that in special relativity. The general space-light transformation and the nonuniversal speed of light in this framework are discussed. The difference between the one-way speed and the two-way speed of a light signal is considered in detail. Moreover, the discussion sheds light on the connection between the universality of the light speed and the clock which does not read universal time. The relation with special relativity theory is examined. ERA

N77-28017# Kanner (Leo) Associates, Redwood City, Calif.
FORMATION OF STRUCTURES IN NONLINEAR MEDIA AND NONEQUILIBRIUM THERMODYNAMICS OF AGGRAVATION REGIMES
N. V. Zmitrenko, S. P. Kurdyumov, A. P. Mikhaylov, and A. A. Samarskii 1976 63 p refs Transl. into ENGLISH of Preprint-74 Inst. Prikl. Mat., Akad. Nauk SSSR, Moscow, 1976 Prepared for Los Alamos Sci. Lab.
(LA-tr-76-32; Preprint-74) Avail: NTIS HC A04/MF A01

In a medium described by quasilinear transport equations (the thermal conductivity, conductivity and viscosity coefficients depend on temperature, density and magnetic field), the effect of nonlinear bulk heat sources, under specific conditions, generates strongly nonequilibrium processes. They can cause heat localization and magnetic field phenomena on certain space scales or in certain sections of the mass in a compressible medium. This results in different spatial distribution of the quantities indicated, i.e., development of different types of structures in the medium. On the basis of the quasilinear thermal conductivity equation with nonlinear bulk heat sources, the characteristics of the strongly nonequilibrium thermodynamics which cause such a complication of organization of the medium were found. ERA

N77-28018# Texas Univ., Austin. Center for Particle Theory.
TIME EVOLUTION OF UNSTABLE QUANTUM STATES AND A RESOLUTION TO ZENO'S PARADOX
C. B. Chiu, E. C. G. Sudarshan, and B. Misra 1976 20 p refs
(Contract E(40-1)-3992)
(ORO-3992-284) Avail: NTIS HC A02/MF A01

The time evolution of quantum states for unstable particles can be conveniently divided into three domains: the very short time where Zeno's paradox is relevant, the intermediate interval where the exponential decay holds more or less, and the very long time where the decay is governed by a power law. Several questions relating to the deviations from the simple exponential decay law are re-examined. On the basis of general considera-

tions, it is demonstrated that deviations from exponential decay near t = 0 are inevitable. General resonance models are formulated for the decay. From analytic solutions to specific narrow width models, one estimates the time parameters T1 and T2 separating the three domains. The parameter T1 is found to be much less than the lifetime GAMMA-1, while T2 is much greater than the lifetime. For instance for the charged pion decay, T1 approximately 10 to the-14th power approximately 190/GAMMA. A resolution to Zeno's paradox provided the present consideration and its limitations are discussed. ERA

N77-28019# Texas Univ., Austin. Center for Particle Theory.
PROPERTIES OF QUANTUM MARKOVIAN MASTER EQUATIONS
Vittorio Gorini, A. Frigerio, M. Verri, A. Kossakowski, and E. C. G. Sudarshan Nov. 1976 45 p refs
(Contract EY-76-S-05-3992)
(ORD-3992-287) Avail: NTIS HC A03/MF A01

Some general structural properties of the dynamics of quantum open Markovian systems are explored. The problem of the classification of quantum Markovian master equations and the limiting conditions under which the dynamical evolution of a quantum open system obeys an exact, semigroup law (weak coupling limit and singular coupling limit) are reviewed. A general form of quantum detailed balance and its relation to thermal relaxation and to microreversibility are discussed. ERA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N77-28020*# Oklahoma Univ., Norman. College of Engineering.
NASA SPACE SCIENCES SYMPOSIUM-1977 Final Report
1977 135 p Symp. held at Norman, Okla., 17-18 Mar. 1977
(NASw-3020)
(NASA-CR-153959) Avail: NTIS HC A07/MF A01 CSCL 05B

The primary objective of the symposium was to motivate American Indians and other minority youths and women to select science and engineering as viable career choices, thereby making them available to the technical work force. Other objectives were: (1) to determine how aerospace technology careers and aerospace activities can be made more relevant to minorities and women; (2) to provide an opportunity for key NASA officials to interact with teachers and counselors of the participating schools; (3) to stimulate a greater interest among American Indian organizations and students in NASA's research and development programs; (4) to help NASA's efforts in the recruiting of minorities and women into its work force; and (5) to provide opportunities for minority aerospace scientists and engineers to interact with the minority community, particularly with youths at the junior high school and high school levels. Author

N77-28021# Management Technology, Inc., Berkeley, Calif. Career Projects Div.
CAREER GUIDANCE FOR SCIENCE STUDENTS: SYSTEMS, PRACTICES AND DATA BASE Final Report, 1 Nov. 1974 - 31 Dec. 1975
Margaret Thal-Larsen and Gerald R. Parrish Dec. 1975 266 p refs
(Grant NSF EPP-74-20284)
(PB-264517/4; MT-NSF-75-02) Avail: NTIS HC A12/MF A01 CSCL 05I

The following is provided: (1) a resume of theories underlying career guidance, (2) an overview of guidance practices and materials, (3) the relationship of career guidance to career education, (4) a comparative treatment of major computerized career guidance systems, and (5) discussion of several shortcomings in the data base and delivery methods utilized by these and the more conventional systems. GRA

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N77-28022* National Aeronautics and Space Administration, Washington, D. C.
LABOR-MANAGEMENT RELATIONS
Jul. 1977 58 p
(NASA-TM-74763; NHB-3711-9) Avail: NASA Headquarters, Washington, D.C., Management Issuances and Information Branch CSCL 05A

Requirements, responsibilities, and procedures for the implementation of Executive Order 11491 are described. Emphasis is placed on the guidance of labor-management relations practitioners and management officials who carry out NASA's relationships with labor organizations as defined in the Order. J.M.S.

N77-28023# California Univ., Berkeley. Operations Research Center.
PLANNING AND CONTROL UNDER RISK Final Report
William S. Jewell Aug. 1976 30 p refs
(Grant DAGC04-75-G-0163)
(AD-A037013; ARO-12549.17-M) Avail: NTIS HC A03/MF A01 CSCL 12/2

This report describes work in the modelling of stochastic phenomena and the development of decision-making techniques under risk and uncertainty. Research areas which received major emphasis were (1) basic risk decision models, with emphasis on determining the structure of optimal policies and examining the implications of different risk objectives; (2) problems of data collection, estimation, and updating for realistic decision models. Author (GRA)

N77-28024# Decisions and Designs, Inc., McLean, Va.
STEP-THROUGH SIMULATION: A METHOD FOR IMPLEMENTING DECISION ANALYSIS
Jacob W. Ulvila (Harvard Univ.), Rex W. Brown, and L. Scott Randall Nov. 1976 68 p refs
(Contract N00014-75-C-0426)
(AD-A036969; TR-76-18) Avail: NTIS HC A04/MF A01 CSCL 12/2

This report describes the initial development of the step-through variant of Monte Carlo simulation, a new procedure for implementing decision analysis or for training decision makers. Like regular Monte Carlo simulation it involves sampling possible aftermaths of an initial action, and generating a distribution of outcome values for it. However, the detailed structure and/or assessments of the decision mode! are elicited as called for in the execution of each trial. It therefore permits substantial economy of elicitation if there are few trials. The step-through procedure also offers economy of elicitation and calculation over a traditional extensive-tree decision-analytic model without requiring simplifications or aggregations in the model's conceptualization. GRA

N77-28025# Cornell Univ., Ithaca, N.Y. School of Operations Research and Industrial Engineering.
OPTIMAL POLICY FOR DATABASE BATCH OPERATIONS: BACKUP, CHECKPOINTING, AND BATCH UPDATE
John A. Muckstadt and Guy M. Lohman Sep. 1976 24 p refs
(Contract N00014-75-C-1172)
(AD-A037233; TR-312) Avail: NTIS HC A02/MF A01 CSCL 09/2

The purpose of this paper is to present a general model for determining the optimal frequency of batch operations. Specifically, optimal backup, checkpointing, and batch updating policies are derived. Our approach exploits inventory parallels, by seeking the optimal number of items--rather than a time interval--to trigger a batch. The Renewal Reward Theorem is used to find the average long run costs for backup, recovery, and item storage, per unit time, which is then minimized to find the optimal backup policy. This approach allows us to make far less restrictive assumptions about the updata arrival process than did previous models, as well as to include storage costs for the updates. The optimal checkpointing and batch updating policies are shown

to be special cases of this optimal backup policy. The derivation of previous results as special cases of this model, and an example, demonstrate the generality of the methodology we develop.
Author (GRA)

N77-28026# Air Force Geophysics Lab., Hanscom AFB, Mass. Technical Programs Branch.
AFGL FISCAL YEAR 1978, AIR FORCE TECHNICAL OBJECTIVES DOCUMENT
Oct. 1976 29 p Supersedes AFGL-TR-76-0002 (AD-A039054; AFGL-TR-76-0266; AFGL-SR-199; AFGL-TR-76-0002) Avail: NTIS HC A02/MF A01 CSCL 05/1

This report comprises the Air Force Geophysics Laboratory Fiscal Year 1978 Technical Objectives Document, and describes the five Technical Planning Objectives in environmental technology. The environmental areas of concern include optical and space physics, meteorology, aeronomy and terrestrial sciences.
Author (GRA)

N77-28027# National Oceanic and Atmospheric Administration, Washington, D. C. Office of Coastal Zone Management.
COASTAL ZONE MANAGEMENT ANNOTATED BIBLIOGRAPHY
David Laist Jan. 1977 478 p
(PB-265270/9; NOAA-77030403) Avail: NTIS HC A21/MF A01 CSCL 13B

The Coastal Zone Management Annotated Bibliography is a reference source for locating information developed through Federal and state coastal zone management (CZM) efforts supported in part or completely by funds authorized under the Coastal Zone Management Act of 1972 (Public Law 92-583). It includes documents prepared by the Office of Coastal Zone Management (OCZM), as well as selected products of coastal zone management programs in the states and territories. In chronological order, by state, 422 annotations are included, all of which are documents published between February 1974 and October 1976. GRA

N77-28028# New York Univ., N. Y. Div. of Applied Science.
MANAGEMENT STUDY OF A MERGED LARGE-SCALE FLUID DYNAMICS LABORATORY: A JOINT UNIVERSITY-INDUSTRY VENTURE Final Report
John R. Ragazzini Jul. 1976 47 p refs
(Grant NSF NM-44395)
(PB-264979/6; NYU-AS-75-06) Avail: NTIS HC A03/MF A01 CSCL 05A

In order to maintain an expensive large scale fluid dynamics laboratory facility at a high level of utilization, the sharing of its equipment and its operating personnel by a number of organizations is desirable. A unique feature of the merged laboratory under study is that it brings together the fluid dynamics laboratories belonging to an industrial corporation (GASL) and an educational institution (NYU) with provisions for further increase of the number of participating institutions. Management problems such as organizational structure, equipment transfer and use, financial arrangements, personnel policies and legal questions are considered. Comparisons with existing consortia are made and certain common features with the NYU/GASL merged laboratory are described. General recommendations for the management of the NYU/GASL facility are described. The applicability of these recommendations to the general class of industry-university joint laboratories is pointed out. GRA

N77-28029# California Univ., Berkeley. Research Management Improvement Project.
CRITICAL ISSUES INVOLVED IN THE REVIEW OF RESEARCH PROPOSALS AT UNIVERSITIES. ONE OF A SERIES OF RESEARCH STUDIES UNDER THE RESEARCH MANAGEMENT IMPROVEMENT PROJECT Final Report
Arthur B. Jebens, Eugene J. Millstein, and David A. Wearley Dec. 1975 56 p refs
(Grant NSF NM-39538)
(PB-264969/7) Avail: NTIS HC A04/MF A01 CSCL 05A

Critical decision points and responsibilities in the research proposal review process within a university are discussed to assure that commitments being made in the proposal to use the university's resources can be carried out. The detailed characteristics of the UC San Diego and UCLA review processes are outlined in workflow and linear responsibility charts. Alternative procedures for considering some of these issues are identified and evaluated, and suggestions are made as to the factors that institutions should consider in developing or improving their systems of internal review and related organizational assignments of responsibility. GRA

N77-28030# California Univ., La Jolla. Research Management Improvement Project.
PROPOSAL PREPARATION, NEGOTIATION AND AWARD. ONE OF A SERIES OF ANALYSES AND IMPACT REPORTS ON MAJOR FEDERAL REQUIREMENT AREAS Final Report
Arthur B. Jebens Sep. 1974 95 p refs
(Grant NSF NM-39538)
(PB-264980/4) Avail: NTIS HC A05/MF A01 CSCL 05A

Federal agency requirements relating to proposal preparation, negotiation and award are characterized by the excessive volume of material used to describe the requirements and the extent of minor variations among and within agencies on the same basic theme. Tables summarize twenty-two requirements of nine Federal agencies involved in proposal preparation, negotiation and award to document the extent of these variations. A number of unique and significantly burdensome requirements of individual agencies are identified and their impact on universities analyzed. An extensive list of findings is included as well as discussions of the impact of these requirements in terms of cost, effort, delays, introduction of conflict, academic issues, nonstandardized requirements and recordkeeping. GRA

N77-28031# California Univ., Berkeley. Research Management Improvement Project.
FEDERAL PROCUREMENT REQUIREMENTS. ONE OF A SERIES OF ANALYSES AND IMPACT REPORTS OF MAJOR FEDERAL REQUIREMENT AREAS Final Report
William E. Moser, Jr. Jul. 1975 51 p refs
(Grant NSF NM-39538)
(PB-264982/0) Avail: NTIS HC A04/MF A01 CSCL 05A

The philosophy which calls for minimal federal requirements consistent with responsible stewardship is demonstrated in a case study. Within the area of procurement requirements, two models for rebudgeting - the Agency Approval system and the Institutional Approval system are identified. The federal requirements associated with the two systems are described, and the Berkeley campus process for implementing the requirements is reviewed. The impact on the University of the requirements is then analyzed in terms of the advantages and disadvantages of each model. Five selected areas of the procurement function as they operate on the Berkeley campus and have been affected by federal requirements are discussed. GRA

N77-28032# National Association of Coll. and Univ. Business Officers, Washington, D. C.
REVIEW AND ASSESSMENT OF RESEARCH MANAGEMENT IMPROVEMENT PROGRAM PROJECT Final Report, 16 Jul. - 31 Dec. 1976
Steven C. Hychka and D. F. Finn 14 Mar. 1977 14 p
(PB-265012/5; NACUBO-1) Avail: NTIS HC A02/MF A01 CSCL 05A

An assessment by college and university business officers of 18 research projects is presented. Ten of these projects contributed to the understanding of the burdensome problem on federal agencies and institutions of federal regulatory requirements which contribute to lack of uniformity in meeting federal accountability needs and to increasing the paperwork burden on both institutions and the federal government. Six of the projects appear to make substantial contributions to individual institutions in addressing their own research management problems and in finding new approaches and new solutions. Two of the projects provided general services designed to be available to all institutions; these two appear to be a very successful service.
GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software.*

N77-28033# National Academy of Sciences - National Research Council, Washington, D. C. Urban Information Systems Inter-Agency Committee (USAC) Support Panel.

AN INFORMATION SYSTEMS RESOURCE CENTER FOR LOCAL GOVERNMENTS

Nov. 1976 18 p

(Contract HUD-H-1221)

(PB-264643/8) Avail: NTIS HC A03/MF A01 CSCL 05B

The mission, organization, programs, operating principles and priorities of an Information Systems Resource Center are described. The study was conducted by the Urban Information Systems Inter-Agency Committee (USAC) Support Panel under the National Research Council. The Support Panel recommended the establishment of a nonprofit information systems resource center. The center would provide local governments with reliable advice on the potential of information systems and keep them informed on public policy issues related to computer usage. The Federal Government would provide seed money to get the center started, but local government organizations would guide its policies.GRA

N77-28034# Advisory Group for Aerospace Research and Development, Paris (France).

MAXIMIZING EFFICIENCY AND EFFECTIVENESS OF INFORMATION DATA BANKS

Y. M. Braunstein (New York Univ.) May 1977 18 p refs Sponsored in part by NSF

(AGARD-R-657; ISBN-92-835-1243-x) Avail: NTIS HC A02/MF A01

Principles are examined underlying the efficient and effective production, transfer, and use of information. The cost savings and benefits that accrue to users from increased cooperation among the participants in the information transfer process are studied. Cooperation between producers, intermediaries, and users is covered. The impact of networking on information services is discussed. Distinctions are made among computer, communication, and information networks. Author

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

N77-28035# Committee on Science and Technology (U. S. House).

NASA AUTHORIZATION, 1978, VOLUME 2, PART 2

Washington GPO 1977 275 p refs Hearings on H.R. 2221 (superseded by H.R. 4088) before Subcomm. on Transportation, Aviation and Weather of Comm. on Sci. and Technol., 95th Congr., 1st Sess., No. 1, 16-17 Feb. 1977

(GPO-88-446) Avail: Subcomm. on Transportation, Aviation and Weather

NASA programs in aeronautical research and development are described to justify budgetary requests for FY-1978. Included is a discussion of NASA policies by a member of the civil aviation industry. A.R.H.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N77-28036 Kansas Univ., Lawrence.

THE DEVELOPMENT OF COSTS RECOVERY SCHEME: SUGGESTED APPROACHES FOR MUNICIPAL OR REGIONAL WASTEWATER TREATMENT PLANTS Ph.D. Thesis

Alexander Aristotelis Thomopulos 1976 137 p

Avail: Univ. Microfilms Order No. 77-2289

Various cost allocations and user charge methods for services provided by municipal or regional wastewater treatment plants are examined, and a reasonable approach to costs recovery for financing treatment systems is developed under some of the guidelines of the 1972 Federal Water Pollution Control Act Amendments, PL 92-500. Some of the basic conclusions are: (1) charge method based on treatment costs of a treatment plant provides a more visible basis for levying charges without any implications, such as the problems of measuring damages in a stream; and (2) the federal government's proposal that a municipality recover a portion of the federal construction grant from only industrial dischargers defies the principle of economics - the burden of costs must be placed on all dischargers. Dissert. Abstr.

N77-28037*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

MIUS INTEGRATION AND SUBSYSTEM TEST (MIST) DATA SYSTEM

L. Marion Pringle Apr. 1977 195 p ref

(NASA-TM-X-58201; JSC-11871) Avail: NTIS HC A09/MF A01 CSCL 05A

A data system for use in testing integrated subsystems of a modular integrated utility system (MIUS) is presented. The MIUS integration and subsystem test (MIST) data system is reviewed from its conception through its checkout and operation as the controlling portion of the MIST facility. The MIST data system provides a real time monitoring and control function that allows for complete evaluation of the performance of the mechanical and electrical subsystems, as well as controls the operation of the various components of the system. In addition to the aforementioned capabilities, the MIST data system provides computerized control of test operations such that minimum manpower is necessary to set up, operate, and shut down subsystems during test periods. Author

N77-28038# California Univ., Livermore. Lawrence Livermore Lab.

HAWAII TECHNOLOGY UTILIZATION EXPERIMENT

David W. Dorn and Charles F. Miller 8 Dec. 1976 42 p

(Contract W-7405-eng-48)

(UCID-17343) Avail: NTIS HC A03/MF A01

A one year technology transfer project involving ERDA installations in Hawaii is described. Teams were sent on week long field trips every two months to test the effectiveness of different methods of transferring technology information from federal sources to civilian clients. Most inquiries involved biomass and use of agricultural wastes, solar energy, and transportation. Author (ERA)

N77-28039# Brookhaven National Lab., Upton, N. Y. Dept. of Chemistry.

BROOKHAVEN PROCEDURES FOR STATISTICAL ANALYSES OF MULTIVARIATE ARCHAEOMETRIC DATA

Edward V. Sayre 1976 31 p refs Presented at Conf. on Applications of Physical Sciences to Medieval Archaeology, Los

Angeles, 18 mar. 1975
(Contract E(30-1)-16)
(BNL-21693; Conf-750355-3) Avail: NTIS HC A03/MF A01

Methods found to be practical and useful in the evaluation of multicomponent neutron activation analyses and related studies of archaeological artifacts are presented. The methods were applied most extensively and successfully to data on pottery and related clays. The subject is treated under the following topics: (1) the use of log normal distributions; (2) clustering methods, (3) preliminary univariate, element-by-element, evaluation of the groups indicated by clustering, multivariate probability calculations; (4) the need for multivariate data handling, (5) use of characteristic vectors of the variance covariance matrix, (6) standardized multivariant coordinates, (7) the handling of missing data; and (8) auxiliary programs. It is concluded that multivariate techniques must ultimately be employed to resolve a set of data fully, but that much can be accomplished by more simple element-to-element methods.
Author (ERA)

N77-28040# Demetroulis (Nicholas M.) and Associates, Alexandria, Va.
TECHNICAL REVIEW AND ANALYSIS OF THE TOTAL UTILITY DEMONSTRATION PLANT DESIGN AND OPERATIONAL CONCEPT Final Report
Nicholas M. Demetroulis Sep. 1976 58 p
(Contract DAAK02-75-C-0096)
(AD-A037016; USAFESA-RT-2031) Avail: NTIS HC A04/MF A01 CSCL 10/2

The total utilities concept involves the furnishing of all utilities to a facility from a single plant as a means of more efficiently using available energy from our fuel sources. These utilities would consist of all or part of the following: electricity, heating and air conditioning, water supply, sewage treatment, domestic hot water and trash disposal. The current practice is to obtain most of the above services from separate, non-affiliated corporate entities whose plants are widely separated and who have little incentive for cooperative action in waste energy utilization. Most electric generating plants, for example, are of large capacity and are remotely located so that even though vast waste energy quantities are available, the cost for collection, storage and distribution of such energy to consumers is prohibitive. Great amounts of energy are dissipated through cooling water, stack gases and power transmission which result in the loss of up to 60 percent of the energy initially available in the fuel. Another obvious resource waste is the practice of trash disposal through open burning, land fill or incineration without extraction and use of the considerable heat energy available. GRA

N77-28041# National Academy of Sciences - National Research Council, Washington, D. C. Urban Information Systems Inter-Agency Committee (USAC) Support Panel.
LOCAL GOVERNMENT INFORMATION SYSTEMS: A STUDY OF USAC AND THE FUTURE APPLICATION OF COMPUTER TECHNOLOGY
Jun. 1976 62 p refs
(Contract HUD-H-1221)
(PB-264577/8) Avail: NTIS HC A04/MF A01 CSCL 13B

An assessment of the Urban Information Systems Inter-Agency Committee (USAC) Program indicates that the potential of computer systems for improving local government management is not being exploited widely by local government. The uses of computer systems in six USAC cities were studied from the standpoint of cost benefit relationship, transferability of experience between cities, interfaces between computer systems, and privacy-security implications. Recommendations on the improved utilization of computer systems by local governments are included. GRA

N77-28042# Kentucky Univ., Lexington. Coll. of Engineering.
URBAN TRANSPORTATION AND LAND USE Final Report
J. A. Deacon, S. B. Edwins, R. B. Harris, and H. M. Leggett
Jul. 1976 210 p refs
(Contract DOT-OST-50111)
(PB-265010/9; DOT-TST-76T-29) Avail: NTIS HC A10/MF A01 CSCL 13B

The complex relationships among activity, movement, and land use are explored. Techniques for coordinated land and transportation development are suggested that support goals of increasing transportation efficiency, reducing the need for motor vehicle travel, improving the quality of urban life, and maintaining the vitality of cities. Diverse topics are addressed including urban form, carpooling, travel disincentives and restraints, walking, zoning, travel behavior, citizen participation, access design, noise, development management, and others. GRA

N77-28043# Environmental Protection Agency, Washington, D.C. Office of Water Supply.
THE REPORT TO CONGRESS: WASTE DISPOSAL PRACTICES AND THEIR EFFECTS ON GROUND WATER. EXECUTIVE SUMMARY Final Report
Jan. 1977 52 p refs
(PB-265364/0; EPA-570/9-77-002) Avail: NTIS HC A04/MF A01 CSCL 13B

The use and occurrence of the ground water resource is described along with the mechanism of contamination. Waste disposal practices and their impact on the ground water environment and the sources of potential contaminants and their various routes to the ground water system are included. Waste disposal practices discussed are those activities which result in the actual collection and disposal of liquid, semi-solid, and solid wastes. The present status of Federal legislation that applies to ground water quality protection and the various regulatory alternatives and strategies available to state and local agencies is defined. J.M.S.

N77-28044# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Geologic Aspects of Radioactive Waste Disposal.
REPORT TO THE DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY, UNITED STATES ATOMIC ENERGY COMMISSION
May 1966 100 p
(PB-265196/6) Avail: NTIS HC A05/MF A01 CSCL 18G

Contents: Historical review; Acknowledgments; Observations (general, geology, hydrology); General principles; Research and development program of division of reactor development and technology (disposal in salt, grout injections in shale, solidification of liquid waste, ion exchange studies, bedrock storage at Savannah River Plant, deep well disposal, geophysical studies at national reactor testing station, ground disposal of gaseous wastes); operational procedures; deep exploratory drilling; Disposal vaults in desert hills; General conclusions; resume of recommendations. GRA

N77-28045# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Radioactive Waste Management.
DISPOSAL OF SOLID RADIOACTIVE WASTES IN BEDDED SALT DEPOSITS
Nov. 1970 33 p refs
(Contract AT(30-1)-4155)
(PB-265197/4) Avail: NTIS HC A03/MF A01 CSCL 18G

The technical feasibility of the burial of solid radioactive wastes in bedded salt deposits was examined. To assist in the evaluation of the plans a Panel on Disposal in Salt Mines was convened. Based on the recommendations of the panel, it was concluded that the use of bedded salt for the disposal of radioactive wastes is satisfactory. In addition, it is the safest choice now available, provided the wastes are in an appropriate form and the salt beds meet the necessary design and geological criteria. The site near Lyons, Kansas was considered to be satisfactory, subject to the development of certain additional confirmatory data and evaluation. Initial disposal will be for low level solid waste material contaminated with plutonium and other long-lived transuranium nuclides. Subsequent disposal will include highly radioactive, high temperature, solidified wastes. GRA

N77-28046# Institute for Defense Analyses, Arlington, Va. Program Analysis Div.
EVALUATION OF RAIL RAPID TRANSIT AND EXPRESS BUS SERVICE IN THE URBAN COMMUTER MARKET Final Report
J. Hayden Boyd, Norman Asher, and Elliot S. Wetzler Oct. 1973 267 p refs
(Contract DOT-OST-20019)

(PB-265236/0; DOT-TPI-10-77-11) Avail: NTIS HC A12/MF A01 CSCL 13B

Public transportation alternatives for serving the commuter market were investigated. The two main alternatives, rail rapid transit and integrated express bus service, are analyzed from the standpoint of full costs (both supplier and user time costs). User time costs of the two alternatives are roughly equal; however, the supplier costs of the integrated bus service are much lower than those of rail rapid transit. Quantitative data on fuel consumption and emissions are presented, and the effects of political, regulatory, and institutional constraints are discussed. GRA

N77-28047# Peat, Marwick, Mitchell and Co., Washington, D.C.
A STUDY OF URBAN MASS TRANSPORTATION NEEDS AND FINANCING
Washington DOT Jul. 1974 154 p refs
(Contract DOT-OST-40064)
(PB-265242/8; DOT-TPI-10-77-04) Avail: NTIS HC A08/MF A01 CSCL 13B

Urban mass transportation needs are analyzed for the long-range (1990) and mid-range (1980) future in terms of capital investments, level of service, passenger demand, and operating and maintenance costs. Historical trends in fare structures and levels are analyzed for 36 typical urbanized areas in four population categories. Relationships between performance and cost are explored, with special attention given to a comparison of rail and bus performance and cost characteristics. GRA

N77-28048# Advisory Group for Aerospace Research and Development, Paris (France).
METHODS OF TECHNOLOGICAL FORECASTING
F. Hetman May 1977 43 p refs
(AGARD-R-655; ISBN-92-835-1240-5) Avail: NTIS HC A03/MF A01

Future research and technology forecasting are discussed. Projective, prospective, and decisional research are considered applied to airline operations, emphasizing the speed trends in various aircraft. J.A.M.

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N77-28049 Ohio State Univ., Columbus.
THE SPECTRAL CLASSIFICATION OF M-DWARF STARS Ph.D. Thesis
Patricia Chikotas Boeshaar 1976 86 p
Avail: Univ. Microfilms Order No. 77-2351

A spectral classification scheme is presented for M-dwarf stars based on a study of the visual region (lambda 4400-6800) in the spectra of 75 M dwarfs and late-type K dwarfs. The temperature classification of the early M dwarfs depends on the appearance of different TiO bands rather than the absolute strength of a particular band. For dwarfs M5 and later the spectral types depend on visual estimates of the ratio of the VO lambda 5736 to TiO lambda 5759 band strengths plus the rapid increase in the strength of the lambda 5530-60 band of CaOH. This CaOH feature first becomes marginally visible near type M3.5. The strengths of the TiO bands appear to change very slowly after type M5 whereas the change in lambda 5530-60 band of CaOH is easily seen. Dissert. Abstr.

N77-28050 Texas Univ., Austin.
MILLIMETER MOLECULAR LINE AND INFRARED OBSERVATIONS OF DENSE CLOUDS ASSOCIATED WITH SMALL H ALPHA EMISSION REGIONS Ph.D. Thesis
Guy Norman Blair, Jr. 1976 144 p
Avail: Univ. Microfilms Order No. 77-3866

A search for new sites of ongoing star formation was made using H alpha emission nebulosity as a guide. The J = 1 to 0 transition of (C-12) (O-16) (115 GHz) was used as a temperature probe of the structure of these regions and thus as an indicator of the position of heating sources embedded in these molecular clouds. Of the 60 H alpha regions surveyed, 30 distinct areas of CO emission enhanced in one or more localized areas were detected. Several are very strong molecular emission sources, and some appear to be quite simple in structure compared to giant molecular cloud/HII region complexes. A search for high density cores of these new regions was made using three transitions of H2CO. The column density of the -13(CO(110 GHz) isotopic species was used as a rough guide for the formaldehyde survey. Dissert. Abstr.

N77-28051 Texas Univ., Austin.
THE OUTER ATMOSPHERES OF M-SUPERGIANT STARS Ph.D. Thesis
Andrew Plous Bernat 1976 307 p
Avail: Univ. Microfilms Order No. 77-3865

The full expanding extended geometry formulation of the radiative transfer equation was used to analyze data from early and recent observations of the M- supergiants. The combined analysis permits a theoretical prediction of the possibility of observationally detectable emission due to scattering in the gas shells and subsequent observational verification. Results of the extended geometry calculations indicate that column densities in the gas shells must be revised downward, but that the physical extents of the shells are considerably larger than previously assumed. Analysis of the MgII h and k lines observed with the Copernicus satellite indicates the presence of an optically thick, turbulent region between the chromospheres and cool gas shells of these stars. Dissert. Abstr.

N77-28052*# Scientific Translation Service, Santa Barbara, Calif.
MODELS OF THE OUTFLOWING ENVELOPES OF STARS OF THE T TAU TYPE
G. S. Bisnovatyy-Kogan and S. A. Lamzin Washington NASA Jun. 1977 26 p refs Transl. into ENGLISH of "Modeli Istekayushchikh Obolochek Zvezd, Tipa T Tau', Rept. Pr-295 Inst. of Space Res., Acad. of Sci. USSR, Moscow, 1976 p 1-30
(Contract NASw-2791)
(NASA-TT-F-17540; PR-295) Avail: NTIS HC A03/MF A01 CSCL 03A

A model of the envelopes of T Tau stars is advanced to explain the observational data in which the envelope is a hot corona flowing outward radially like the solar wind. It is found that different T Tau stars have very diverse characteristics. Author

N77-28053*# Kanner (Leo) Associates, Redwood City, Calif.
OPTICAL CHARACTERISTICS OF THE ACCRETION DISK IN THE SYSTEM HZ HER (HER X-1)
G. S. Bisnovatyy-Kogan, A. V. Goncharskiy, B. V. Komberg, A. M. Herepashchuk, and A. G. Yagola Washington NASA Jun. 1977 31 p refs Transl. into ENGLISH of "Opticheskiye Kharakteristiki Akkretsionnogo Diska v Sisteme HZ Her (Her X-1)", Rept. Pr-293 Inst. of Spale Res., Acad. of Sci. USSR, Moscow, 1976 31 p Original language document was announced as A77-34976
(Contract NASw-2790)
(NASA-TT-F-17539; Pr-293) Avail: NTIS HC A03/MF A01 CSCL 03A

Photoelectric UBVr observations in the region of the main minimum of HZ Her were analyzed in order to investigate the properties of the optical object around the neutron star. The observational data of ten nights were used in different phases of a 35 day cycle in the region of the main minimum. A secondary maximum of X-ray emission was observed in the middle of the off state which appears to have a regular character. Asymmetry of the poles of the magnetic field may explain the differences between the on and off states. Author

N77-28054*# Computer Sciences Corp., El Segundo, Calif.
TABLES OF ASTRONOMICAL CONSTANTS AND LIBRATION-POINT PARAMETERS FOR SELECTED SOLAR SYSTEM OBJECTS
David W. Dunham Jan. 1977 30 p refs
(Contract NAS5-1199)
(NASA-CR-152544; CSC/TM-77/6025) Avail: NTIS HC A03/MF A01 CSCL 03A

Values for the masses, radii, and certain mean orbital elements for most of the planets and many of the satellites of the solar system are presented. These values were used to produce computer-generated tables of libration point parameters. Author

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

No abstracts in this category.

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N77-28055*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PIONEER ODYSSEY
Richard O. Fimmel Washington 1977 229 p refs Revision of N75-10130 For NASA-SP-349 see also NASA-SP-396
(NASA-SP-349; NASA-SP-396) Avail: NTIS MF A01; SOD HC 9.85 CSCL 03B

The Pioneer Jupiter Mission is discussed in terms of objectives, hazards, spacecraft design, and communication techniques. The scientific payloads of both Pioneer 10 and Pioneer 11 designed to gather knowledge on interplanetary space beyond Mars and on the Jovian system are included. Mission accomplishments are described. J.M.S.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N77-28056# Lockheed Missiles and Space Co., Palo Alto, Calif.
RESEARCH ON THE DYNAMICS OF THE SOLAR ATMOSPHERE Final Report, 15 Oct. 1975 - 30 Sep. 1976
Robert C. Smithson 31 Oct. 1976 18 p
(Contract F19628-76-C-0044; AF Proj. 7649)
(AD-A038522; LMSC-D554710; AFGL-TR-76-0254) Avail: NTIS HC A02/MF A01 CSCL 03/2

Observations have been made of solar magnetic and velocity fields using the Lockheed universal filter and the Lockheed high speed video image processor. Inter-relationships between magnetic and velocity fields, fine structure of the magnetic field, and absolute magnetic field strengths were studied. GRA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N77-28057*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UNUSUAL INTERACTIONS ABOVE 100 TeV: A REVIEW OF COSMIC RAY EXPERIMENTS WITH EMULSION CHAMBERS
D. B. Yodh Jul. 1977 37 p refs Presented at the Brookhaven Symp. on Prospects of Strong Interaction Phys., Isabelle, Tenn., Apr. 1977
(Grant NSF PHY-77-01438)
(NASA-TM-X-71358; X-661-77-174) Avail: NTIS HC A03/MF A01 CSCL 03B

A method is given for analyzing the space correlated collection of jets (gamma ray families) with energies greater than 100 TeV in Pb or Fe absorber sampled by photosensitive layers in an emulsion chamber. Events analyzed indicate large multiplicities of particles in the primary hadron-air interaction, and a marked absence of neutral pions. Author

N77-28058*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SAS-2 OBSERVATIONS OF THE DIFFUSE GAMMA RADIATION IN THE GALACTIC LATITUDE INTERVAL 10 DEG > ABSOLUTE b < OR EQUAL TO 90 DEG
C. E. Fichtel, R. C. Hartman, D. A. Kniffen, D. J. Thompson, H. B. Oegelman (Middle East Tech. Univ., Ankara), M. E. Oezel (Middle East Tech. Univ., Ankara), and T. Tuemer (Middle East Tech. Univ., Ankara), Jun. 1977 19 p refs Submitted for publication
(NASA-TM-X-71359; X-662-77-141) Avail: NTIS HC A02/MF A01 CSCL 03B

An analysis of all of the second small astronomy satellite gamma-ray data for galactic latitudes with the absolute value of b 10 deg has shown that the intensity varies with galactic latitude, being larger near 10 deg than 90 deg. For energies above 100 MeV the gamma-ray data are consistent with a latitude distribution of the form I(b) = C sub 1 + C sub 2/sin b, with the second term being dominant. This result suggests that the radiation above 100 MeV is coming largely from local regions of the galactic disk. Between 35 and 100 MeV, a similar equation is also a good representation of the data, but here the two terms are comparable. These results indicate that the diffuse radiation above 35 MeV consists of two parts, one with a relatively hard galactic component and the other an isotropic, steep spectral component which extrapolates back well to the low energy diffuse radiation. The steepness of the diffuse isotropic component places significant constraints on possible theoretical models of this radiation. Author

N77-28059# Los Alamos Scientific Lab., N. Mex.
SIZE LIMITS FOR EXPANDING LIGHT SOURCES
James Terrell 1976 5 p refs Presented at IAU-CNRS Colloq., Paris, 6-8 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2133; Conf-760966-1) Avail: NTIS HC A02/MF A01

The rapid fluctuations of radio and optical brightness which are observed for quasars, as well as for BL Lac objects, place severe upper limits on the possible sizes of these sources. These limits are not essentially changed by the assumption of a relativistically-expanding light source, contrary to widespread opinion. Thus the conflicts between fluctuation size limits for quasars and the minimum surface area needed to radiate sufficient power, if at cosmological distance, are not resolved by relativistic expansion. ERA

99 GENERAL

No abstracts in this category.

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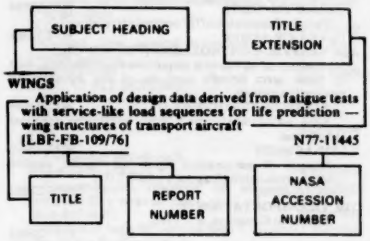

The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7050).

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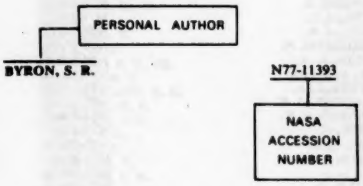

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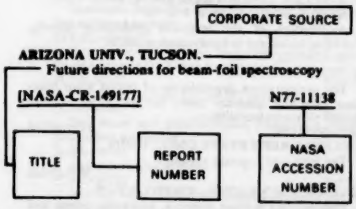

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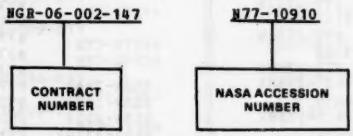

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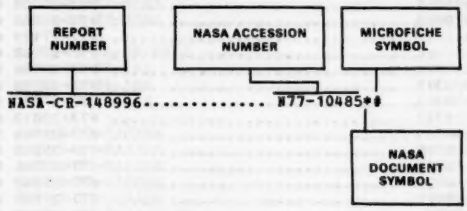

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NASA-CR-135196 ..... N77-27231*#
NASA-CR-135198 ..... N77-27241*#
NASA-CR-135205 ..... N77-27890*#
NASA-CR-135207 ..... N77-27115*+
NASA-CR-135211 ..... N77-27403*#
NASA-CR-135220 ..... N77-27118*#
NASA-CR-141419 ..... N77-27174*#
NASA-CR-141420 ..... N77-27369*#
NASA-CR-141421 ..... N77-27175*#
NASA-CR-143844 ..... N77-27126*#
NASA-CR-144840 ..... N77-27264*#
NASA-CR-144953A ..... N77-27104*#
NASA-CR-145209 ..... N77-27872*#
NASA-CR-145221 ..... N77-27158*#
NASA-CR-145223 ..... N77-27419*#
NASA-CR-145224 ..... N77-27087*#
NASA-CR-150131 ..... N77-27178*#
NASA-CR-150142 ..... N77-27211*#

NASA-CR-150143 ..... N77-27750*#
NASA-CR-150315 ..... N77-27212*#
NASA-CR-150316 ..... N77-27213*#
NASA-CR-150317 ..... N77-27428*#
NASA-CR-150333 ..... N77-27203*#
NASA-CR-150334 ..... N77-27176*#
NASA-CR-150335 ..... N77-27181*#
NASA-CR-150336 ..... N77-27182*#
NASA-CR-150337 ..... N77-27183*#
NASA-CR-150338 ..... N77-27184*#
NASA-CR-151246 ..... N77-27692*#
NASA-CR-151329 ..... N77-27469*#
NASA-CR-151437 ..... N77-27171*#
NASA-CR-151442 ..... N77-27179*#
NASA-CR-151444 ..... N77-27680*#
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NASA-CR-151446 ..... N77-27719*#
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NASA-CR-151450 ..... N77-27169*#
NASA-CR-151457 ..... N77-27191*#
NASA-CR-151458 ..... N77-27162*#
NASA-CR-151459 ..... N77-27168*#
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NASA-CR-151997 ..... N77-27879*#
NASA-CR-152009 ..... N77-27230*#
NASA-CR-152012 ..... N77-27076*#
NASA-CR-152017 ..... N77-27881*#
NASA-CR-152019 ..... N77-27193*#
NASA-CR-152542 ..... N77-27493*#
NASA-CR-152543 ..... N77-27471*#
NASA-CR-152544 ..... N77-28054*#
NASA-CR-152549 ..... N77-27177*#
NASA-CR-152550 ..... N77-27649*#
NASA-CR-152551 ..... N77-27380*#
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NASA-CR-153276 ..... N77-27468*#
NASA-CR-153277 ..... N77-27470*#
NASA-CR-153281 ..... N77-27127*#
NASA-CR-153290 ..... N77-27920*#
NASA-CR-153293 ..... N77-27138*#
NASA-CR-153294 ..... N77-27258*#
NASA-CR-153295 ..... N77-27476*#
NASA-CR-153296 ..... N77-27874*#
NASA-CR-153297 ..... N77-27071*#
NASA-CR-153394 ..... N77-27073*#
NASA-CR-153396 ..... N77-27883*#
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NASA-CR-153701 ..... N77-27170*#
NASA-CR-153742 ..... N77-27268*#
NASA-CR-153743 ..... N77-27307*#
NASA-CR-153744 ..... N77-27166*#
NASA-CR-153745 ..... N77-27172*#
NASA-CR-153748 ..... N77-27646*#
NASA-CR-153889 ..... N77-27912*#
NASA-CR-153902 ..... N77-27482*#
NASA-CR-153903 ..... N77-27481*#
NASA-CR-153904 ..... N77-27501*#
NASA-CR-153905 ..... N77-27502*#
NASA-CR-153906 ..... N77-27503*#
NASA-CR-153908 ..... N77-27504*#
NASA-CR-153909 ..... N77-27505*#
NASA-CR-153912 ..... N77-27682*#
NASA-CR-153913 ..... N77-27108*#
NASA-CR-153914 ..... N77-27074*#
NASA-CR-153959 ..... N77-28020*#

NASA-SP-349 ..... N77-28055*#
NASA-SP-396 ..... N77-28055*#
NASA-SP-400 ..... N77-27155*#

NASA-TM-X-3468 ..... N77-27350*#
NASA-TM-X-3545 ..... N77-27130*#
NASA-TM-X-58201 ..... N77-28037*#
NASA-TM-X-71338 ..... N77-27864*#
NASA-TM-X-71346 ..... N77-27647*#
NASA-TM-X-71349 ..... N77-27648*#
NASA-TM-X-71351 ..... N77-27483*#
NASA-TM-X-71352 ..... N77-27273*#
NASA-TM-X-71353 ..... N77-27484*#
NASA-TM-X-71354 ..... N77-27379*#
NASA-TM-X-71358 ..... N77-28057*#
NASA-TM-X-71359 ..... N77-28058*#
NASA-TM-X-72776 ..... N77-27661*#
NASA-TM-X-72777 ..... N77-27180*#
NASA-TM-X-72825 ..... N77-27427*#
NASA-TM-X-72844 ..... N77-27266*#
NASA-TM-X-73397 ..... N77-27248*#
NASA-TM-X-73630 ..... N77-27568*#
NASA-TM-X-73678 ..... N77-27117*#
NASA-TM-X-73679 ..... N77-27069*#
NASA-TM-X-73683 ..... N77-27214*#
NASA-TM-X-73689 ..... N77-27921*#
NASA-TM-X-73690 ..... N77-27919*#
NASA-TM-X-73909 ..... N77-27132*#
NASA-TM-X-73910 ..... N77-27133*#
NASA-TM-X-73912 ..... N77-27134*#
NASA-TM-X-73913 ..... N77-27135*#
NASA-TM-X-73955 ..... N77-27072*#
NASA-TM-X-74012 ..... N77-27083*#
NASA-TM-X-74025 ..... N77-27908*#
NASA-TM-X-74028 ..... N77-27068*#
NASA-TM-X-74036 ..... N77-27137*#
NASA-TM-X-74037 ..... N77-27876*#
NASA-TM-X-74039 ..... N77-27402*#
NASA-TM-X-74042 ..... N77-27877*#
NASA-TM-X-74754 ..... N77-27709*#
NASA-TM-X-75028 ..... N77-27475*#

NASA-TM-56046 ..... N77-27429*#
NASA-TM-56047 ..... N77-27430*#
NASA-TM-58196 ..... N77-27161*#
NASA-TM-58204 ..... N77-27349*#
NASA-TM-73205 ..... N77-27165*#
NASA-TM-73216 ..... N77-27106*#
NASA-TM-73227 ..... N77-27794*#
NASA-TM-73246 ..... N77-27186*#
NASA-TM-73249 ..... N77-27708*#
NASA-TM-73262 ..... N77-27105*#
NASA-TM-73595 ..... N77-27751*#
NASA-TM-73664 ..... N77-27215*#
NASA-TM-73692 ..... N77-27431*#
NASA-TM-73695 ..... N77-27306*#
NASA-TM-73697 ..... N77-27370*#
NASA-TM-73703 ..... N77-27497*#
NASA-TM-73709 ..... N77-27107*#
NASA-TM-73712 ..... N77-27494*#
NASA-TM-74035 ..... N77-27136*#
NASA-TM-74721 ..... N77-27167*#
NASA-TM-74756 ..... N77-27437*#
NASA-TM-74757 ..... N77-27486*#
NASA-TM-74758 ..... N77-27473*#
NASA-TM-74760 ..... N77-27480*#
NASA-TM-74761 ..... N77-27479*#
NASA-TM-74762 ..... N77-27309*#
NASA-TM-74763 ..... N77-28022*
NASA-TM-75018 ..... N77-27798*#
NASA-TM-75019 ..... N77-27477*#
NASA-TM-75022 ..... N77-27204*#
NASA-TM-75024 ..... N77-27474*#
NASA-TM-75026 ..... N77-27697*#
NASA-TM-75120 ..... N77-27173*#
NASA-TM-75121 ..... N77-27418*#
NASA-TM-75126 ..... N77-27567*#
NASA-TM-75131 ..... N77-27243*#
NASA-TM-75143 ..... N77-27070*#
NASA-TM-75151 ..... N77-27498*#

NASA-TN-D-8344 ..... N77-27406*#
NASA-TN-D-8407 ..... N77-27205*#
NASA-TN-D-8428 ..... N77-27185*#
NASA-TN-D-8495 ..... N77-27075*#
NASA-TN-D-8507 ..... N77-28015*#

NASA-TT-F-17300 ..... N77-27242*#
NASA-TT-F-17368 ..... N77-27269*#
NASA-TT-F-17424 ..... N77-27348*#
NASA-TT-F-17433 ..... N77-27875*#
NASA-TT-F-17435 ..... N77-27891*#
NASA-TT-F-17436 ..... N77-27645*#
NASA-TT-F-17530 ..... N77-27707*#
NASA-TT-F-17531 ..... N77-27708*#
NASA-TT-F-17532 ..... N77-27478*#
NASA-TT-F-17534 ..... N77-27229*#
NASA-TT-F-17539 ..... N77-28053*#
NASA-TT-F-17540 ..... N77-28052*#
NASA-TT-F-17541 ..... N77-27673*#
NASA-TT-F-17542 ..... N77-27909*#
NASA-TT-F-17543 ..... N77-27910*#

NASA-TT-F-17545 ..... N77-27160*#

NAVTRAEQUIPC-IH-265 ..... N77-27154 #

NBS-BSS-93 ..... N77-27252 #

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NBS-SP-400-35 ..... N77-27329 #
NBS-SP-467 ..... N77-27253 #
NBS-SP-468 ..... N77-27563 #
NBS-SP-500-4 ..... N77-27741 #
NBS-SP-500-5 ..... N77-27742 #

NBSIR-76-847 ..... N77-28007 #
NBSIR-76-1148 ..... N77-27455 #
NBSIR-77-853 ..... N77-27326 #
NBSIR-77-855 ..... N77-27327 #
NBSIR-77-1222 ..... N77-27237 #

NCI/IP-TR-12 ..... N77-27786 #
NCI/IP-77-01 ..... N77-27786 #

NELC-TD-506 ..... N77-27288 #

NFD-76D1006 ..... N77-27232*#
NFD-77D1013 ..... N77-27232*#

NHB-3711-9 ..... N77-28022*

NISC-TRANS-3899 ..... N77-27674 #
NISC-TRANS-3902 ..... N77-27360 #

NJIT-NV-10 ..... N77-27780 #

NOAA-TM-ERL-AOML-24 ..... N77-27676 #

NOAA-TM-ERL-ARL-62 ..... N77-27666 #

NOAA-TM-ERL-MESA-9 ..... N77-27675 #

NOAA-TM-ERL-WPL-19 ..... N77-27785 #

NOAA-TR-ERL-384 ..... N77-27658 #
NOAA-TR-ERL-384-PMEL-27 ..... N77-27658 #

NOAA-TR-NOS-68 ..... N77-27255 #
NOAA-TR-NOS-68-NGS-4 ..... N77-27255 #

NOAA-77012502 ..... N77-27255 #
NOAA-77020206 ..... N77-27666 #
NOAA-77021615 ..... N77-27658 #
NOAA-77030214 ..... N77-27657 #
NOAA-77030309 ..... N77-27676 #
NOAA-77030403 ..... N77-28027 #
NOAA-77030802 ..... N77-27785 #
NOAA-77030803 ..... N77-27675 #

NPS-53CS77031 ..... N77-27834 #
NPS-53FE76121 ..... N77-27863 #
NPS-53SR77021 ..... N77-27833 #

NRC-5 ..... N77-27439 #
NRC-76-7 ..... N77-27951 #

NRL-MR-3429 ..... N77-27882 #
NRL-MR-3441 ..... N77-27978 #
NRL-MR-3459 ..... N77-27979 #
NRL-MR-3468 ..... N77-27289 #
NRL-MR-3470 ..... N77-27862 #

NRL-8 ..... N77-27808 #

NSF/PRA-7501069/2/7 ..... N77-27491 #
NSF/PRA-7501069/6/7 ..... N77-27456 #
NSF/PRA-7501069/7/7 ..... N77-27240 #
NSF/RA-760448 ..... N77-27561 #
NSF/RA-760464 ..... N77-27254 #
NSF/RA/W-75-352 ..... N77-27564 #

NSWC/DL-TR-3514 ..... N77-27101 #
NSWC/DL-TR-3627 ..... N77-27159 #

NTISUB/C/138-013 ..... N77-27486*#
NTISUB/C/139-013 ..... N77-27473*#

NYU-AS-75-06 ..... N77-28028 #

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ONRL-C-38-76 ..... N77-27907 #

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ORNL-CSD-TM-17 ..... N77-27699 #

ORNL-NUREG-2 ..... N77-27434 #

ORNL-SUB-3821-1 ..... N77-27442 #

ORNL-TM-5292 ..... N77-27931 #
ORNL-TM-5608 ..... N77-27249 #
ORNL-TM-5632 ..... N77-27947 #
ORNL-TM-5666 ..... N77-27896 #
ORNL-TM-5682 ..... N77-27513 #

ORNL-TR-4034 ..... N77-27218 #
ORNL-TR-4220 ..... N77-27722 #
ORNL-TR-4285 ..... N77-27219 #

ORNL-5192 ..... N77-27520 #

ORO-2504-245 ..... N77-27755 #
ORO-3992-284 ..... N77-28018 #
ORO-3992-288 ..... N77-27868 #
ORO-3992-289 ..... N77-27867 #
ORO-3992-292 ..... N77-28016 #
ORO-4927-76-2 ..... N77-27506 #

OWRT-A-040-NEB(1) ..... N77-27683 #
OWRT-A-042-ARIZ(13) ..... N77-27489 #
OWRT-A-060-HI (1) ..... N77-27488 #
OWRT-A-061-NEV(1) ..... N77-27492 #

P-5686 ..... N77-27796 #
P-5696 ..... N77-27770 #

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PAR-76-35-VOL-1 ..... N77-27783 #
PAR-76-35-VOL-2 ..... N77-27784 #

PB-256181/8 ..... N77-27663 #
PB-264296/5 ..... N77-27445 #
PB-264442/5 ..... N77-27613 #
PB-264443/3 ..... N77-27614 #
PB-264444/1 ..... N77-27615 #
PB-264445/8 ..... N77-27616 #
PB-264446/6 ..... N77-27617 #
PB-264449/0 ..... N77-27562 #
PB-264466/4 ..... N77-27490 #
PB-264494/6 ..... N77-27491 #
PB-264517/4 ..... N77-28021 #
PB-264529/9 ..... N77-27618 #
PB-264538/0 ..... N77-27456 #
PB-264561/2 ..... N77-27240 #
PB-264563/8 ..... N77-27670 #
PB-264577/8 ..... N77-28041 #
PB-264589/3 ..... N77-27316 #
PB-264641/2 ..... N77-27446 #
PB-264643/8 ..... N77-28033 #
PB-264644/6 ..... N77-27619 #
PB-264645/3 ..... N77-27629 #
PB-264689/1 ..... N77-27455 #
PB-264698/2 ..... N77-27626 #
PB-264702/2 ..... N77-27247 #
PB-264715/4 ..... N77-27621 #
PB-264717/0 ..... N77-27492 #
PB-264740/2 ..... N77-27559 #
PB-264760/0 ..... N77-27560 #
PB-264814/5 ..... N77-27253 #
PB-264872/3 ..... N77-27622 #
PB-264885/5 ..... N77-27786 #
PB-264891/3 ..... N77-27625 #
PB-264893/9 ..... N77-27623 #
PB-264898/8 ..... N77-27683 #
PB-264906/9 ..... N77-27624 #
PB-264929/1 ..... N77-27329 #
PB-264932/5 ..... N77-27252 #
PB-264939/0 ..... N77-27328 #
PB-264969/7 ..... N77-28029 #
PB-264979/6 ..... N77-28028 #
PB-264980/4 ..... N77-28030 #
PB-264982/0 ..... N77-28031 #
PB-264989/5 ..... N77-27125 #
PB-265000/0 ..... N77-27667 #
PB-265001/8 ..... N77-27668 #
PB-265002/6 ..... N77-27669 #

PB-265003/4 ..... N77-27561 #
PB-265006/7 ..... N77-27627 #
PB-265010/9 ..... N77-28042 #
PB-265012/5 ..... N77-28032 #
PB-265075/2 ..... N77-27327 #
PB-265076/0 ..... N77-27326 #
PB-265089/3 ..... N77-27237 #
PB-265104/0 ..... N77-27564 #
PB-265109/9 ..... N77-27489 #
PB-265115/6 ..... N77-27254 #
PB-265117/2 ..... N77-27742 #
PB-265139/6 ..... N77-27741 #
PB-265156/0 ..... N77-27715 #
PB-265168/5 ..... N77-27457 #
PB-265171/9 ..... N77-27488 #
PB-265196/6 ..... N77-28044 #
PB-265197/4 ..... N77-28045 #
PB-265236/0 ..... N77-28046 #
PB-265242/8 ..... N77-28047 #
PB-265269/1 ..... N77-27676 #
PB-265270/9 ..... N77-28027 #
PB-265274/1 ..... N77-27785 #
PB-265277/4 ..... N77-27675 #
PB-265364/0 ..... N77-28043 #
PB-265380/6 ..... N77-27666 #
PB-265395/4 ..... N77-27628 #
PB-265421/8 ..... N77-27255 #
PB-265434/1 ..... N77-27658 #
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PB-265456/4 ..... N77-27458 #
PB-265532/2 ..... N77-27620 #
PB-265552/0 ..... N77-27563 #
PB-265815/1 ..... N77-27542 #

PD-LJ-76-132 ..... N77-27393 #

PGSTR-PH77-56 ..... N77-27920*#

POLY-EE/EP-76-011 ..... N77-27980 #
POLY-EE/EP-76-013 ..... N77-27779 #

PPG-288 ..... N77-27975 #
PPG-292 ..... N77-27973 #

PPPL-1297 ..... N77-27929 #
PPPL-1298 ..... N77-27924 #
PPPL-1309 ..... N77-27953 #
PPPL-1310 ..... N77-27948 #
PPPL-1315 ..... N77-27964 #

PR-9 ..... N77-27682*#
PR-293 ..... N77-28053*#
PR-295 ..... N77-28052*#
PR-304 ..... N77-27910*#
PR-306 ..... N77-27673*#

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PREPRINT-151 ..... N77-27971 #

PSD-R-109 ..... N77-27496*#

PSI-TR-60 ..... N77-27397 #

PTR-1033-76-12 ..... N77-27294 #

PWA-5478 ..... N77-27873 #

QPR-1 ..... N77-28005 #
QPR-5 ..... N77-27335 #
QPR-5 ..... N77-27339 #
QPR-15 ..... N77-27410 #

QR-1 ..... N77-27337 #
QR-1 ..... N77-27561 #
QR-2 ..... N77-27340 #
QR-3 ..... N77-27805 #
QR-5 ..... N77-27504*#
QR-7 ..... N77-27502*#
QR-10 ..... N77-27344 #
QR-14 ..... N77-27249 #
QR-18 ..... N77-27341 #

R-742 ..... N77-27850 #
R-751 ..... N77-27325 #
R-2103/1-AF ..... N77-27124 #
R-9967 ..... N77-27923 #

RADC-TM-76-15 ..... N77-27303 #
RADC-TM-76-16 ..... N77-27285 #

RADC-TR-76-101-VOL-3 ..... N77-27330 #
RADC-TR-76-260 ..... N77-27913 #
RADC-TR-76-329-VOL-6 ..... N77-27771 #
RADC-TR-76-358 ..... N77-27302 #
RADC-TR-76-383 ..... N77-27789 #
RADC-TR-76-388 ..... N77-27804 #
RADC-TR-76-405 ..... N77-27779 #
RADC-TR-76-408 ..... N77-27318 #
RADC-TR-76-409 ..... N77-27296 #
RADC-TR-77-13 ..... N77-27320 #
RADC-TR-77-17 ..... N77-27805 #
RADC-TR-77-26 ..... N77-27292 #
RADC-TR-77-28 ..... N77-27735 #
RADC-TR-77-33 ..... N77-27298 #
RADC-TR-77-35 ..... N77-27299 #
RADC-TR-77-39-REV ..... N77-27729 #
RADC-TR-77-42 ..... N77-27284 #
RADC-TR-77-48 ..... N77-27297 #
RADC-TR-77-51-VOL-1 ..... N77-27783 #
RADC-TR-77-51-VOL-2 ..... N77-27784 #
RADC-TR-77-72 ..... N77-27487 #
RADC-TR-77-73 ..... N77-27301 #
RADC-TR-77-87 ..... N77-27797 #
RADC-TR-77-91 ..... N77-27324 #
RADC-TR-77-112 ..... N77-27849 #

RAE-LIB-TRANS-1891 ..... N77-27705
RAE-LIB-TRANS-1914 ..... N77-27405 #

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REPT-42 ..... N77-27454 #
REPT-51 ..... N77-27569 #
REPT-76-104-1A ..... N77-27481*#
REPT-76-104-1B ..... N77-27482*#
REPT-76-1139 ..... N77-28005 #
REPT-76-311851 ..... N77-27517 #
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REPT-77-9F9-DSPLA-R1 ..... N77-27344 #
REPT-77-048 ..... N77-27750*#
REPT-77-1267 ..... N77-27428*#
REPT-160 ..... N77-27479*#
REPT-723-C-2 ..... N77-27789 #
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REPT-1176-1310 ..... N77-27339 #
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REPT-7603 ..... N77-27076*#
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REPT-013376-4-M ..... N77-27300 #
REPT-770112 ..... N77-27665 #

RFP-2492 ..... N77-27223 #

RH-77-1 ..... N77-27395 #

RL-GEN-1142(W/DEL) ..... N77-27225 #

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